CAUSES AND EFFECTS OF COASTAL SAND MINING IN GHANA

John Victor Mensah
Centre for Development Studies, University of Cape Coast, Cape Coast, Ghana

ABSTRACT

Sand mining is a type of open-cast mining that provides material for the construction sector in Ghana. The construction sector in the coastal areas of Ghana relies heavily on coastal sand and pebbles in the building of houses, bridges and roads. Its contribution to Ghana's industrial output has increased from 17.4 per cent in 1986 to 20.8 per cent in 1993. However, the process of sand mining has accelerated coastal environmental degradation to an alarming rate in many areas. As a result the government has been compelled to spend millions of dollars to combat sea erosion. This paper examines the causes and effects of coastal sand mining in three communities in the Ahanta West District of Ghana. It argues that coastal sand needs to be exploited to satisfy human demands but this requires efficient and effective resource management to ensure sustainable development. It also calls for a concerted effort by policy makers, sand contractors, engineers, traditional rulers and local residents to find a solution to the coastal environmental crisis.

INTRODUCTION

Coastlines all over the world have nurtured humanity through countless centuries, serving as a source of food, salt, construction material such as sand and pebbles for housing, and employment to the people. Coastal mangroves, for example, contain resources that shelter a wide range of edible animals and plants, and provide fuelwood, building materials and medicinal plants. Sixty per cent of the world's population now live on or within 100 km of the seashore. The result is too much development and too much competition for limited resources. Today, coastal areas are suffering under an onslaught of human activities (Hinrichsen, 1990).

In West Africa, the effects of urbanisation and the concentration of industrial and commercial activities along the coasts have resulted in an unprecedented exploitation of coastal resources such as coastal sand, mangrove forests, estuaries and seagrass beds. The consequences are coastal erosion, forest loss and pollution by industrial, municipal and agricultural wastes. Coastal erosion is probably the most serious environmental problem facing West African coasts today (Hinrichsen, 1990). Since coastal sand serves as a barrier between the sea and the land, uncontrolled sand mining (known as "sand winning" in Ghana) causes a range of coastal environmental problems.

Ghana has a shoreline of 550 km and its coastal sand is essential to the construction industry. The share of the construction sector which embraces housing, roads, highways and bridges, irrigation and water works in Ghana's

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industrial output increased gradually from 17.4 per cent in 1986 to 20.8 per cent in 1993 (ISSER, 1994). Some coastal inhabitants are engaged in sand mining on a commercial basis. In recent years, some communities have undertaken the activity as a means of financing local development projects. The activity involves scooping, moving, carrying and transporting sand and pebbles, and has resulted in a number of physical, socio-economic and environmental problems, including rapid coastal erosion, land use and land ownership conflicts, damage to feeder roads and the use of child labour. In view of the environmental damage to the coast, the present level of sand mining is not sustainable. It is quite futile to find that while millions of dollars are being spent by the government to combat erosion along coastal areas such as Sekondi, Nkotompo and Keta, some communities are actively encouraging coastal erosion.

There is only limited information on the state of coastal sand and stone mining in West Africa (Biney, 1982; Sackey, 1991; Biney*et al.*, 1993). Biney*et al.* (1993) note that coastal erosion is a major problem in the Greater Accra Metropolitan Area with rates of erosion exceeding 2 m per year in critical areas such as Labadi. They recognise that coastal erosion arises from both natural and human causes. In Ghana, natural causes of erosion are related to sea level rise, estimated at 2 mm per annum (Ibe & Quelennec, 1989) while "human induced erosion is caused by removal of sand and pebbles from beaches for construction purposes and erection of coastal structures such as harbours and lagoon inlets" (Biney*et al.*, 1993:117) as well as the construction of port facilities (Portman, 1978). According to Biney (1982), coastal erosion is particularly serious in the Keta area because no serious efforts have been made to check it. In the Sekondi, Shama and Axim areas, erosion has been checked by the erection of walls of granite blocks. However, the Environmental Protection Council (EPC) (1991) believes that the success of protection works along the coast has been limited and therefore engineering options cannot provide long-term solutions to coastal erosion. Observations indicate that the longshore drift mechanism is such that action in one section of the coast may trigger erosion in adjoining sections (EPC, 1991).

This study identifies and examines the causes and effects of sand mining in three coastal communities in Ghana. It also makes recommendations towards sustainable management of coastal sand and pebbles.

INSTITUTIONAL AND LEGAL ARRANGEMENTS FOR COASTAL RESOURCE MANAGEMENT

Before the government of Ghana established the EPC in 1973, executive powers on the care and protection of the environment was legally nested in a number of official bodies. These powers were so widely scattered among different bodies that not one of them enjoyed exclusive responsibility of the environment. The EPC was established to serve as the custodian of the national environment and coordinated all activities relating to the environment. However, the EPC was primarily an advisory and research organisation without the power to enforce any measures for improving the environment or preventing damage to it. To discharge its responsibilities, the EPC formulated Ghana's Environmental Action Plan (EAP) in 1991 to provide a coherent framework for interventions deemed necessary to safe guard the environment. These interventions fall within the ambit of national environmental policy which aims at ensuring the sound management of environmental resources and avoiding any exploitation of these resources in a manner that might cause irreparable damage to the environment (EPC, 1991). The EAP has a ten-year implementation period, from 1991 to 2000, and addresses issues such as mining, and coastal and marine ecosystems. The implementation of the plan involves

various national agencies. For example, the control of mining activities in Ghana falls under the responsibility of the Ministry of Mines and Energy. In its early years at least, the EPC was not very successful in curbing coastal environment problems (Biney*et al.*, 1993).

In 1994, the government raised environmental issues to ministerial status*viz.*, the Ministry of Environment, Science and Technology (MEST). The EPC was also upgraded and renamed the Environmental Protection Agency (EPA). Under MEST, the EPA has been entrusted with the responsibility of setting and enforcing environmental quality standards. One of MEST's key projects, the Ghana Environmental Resource Management Project (GERMP), has been designed to strengthen inter-sectoral linkages for the management of the environment. It seeks,*inter alia*, to stimulate community participation in environmental management. According to P.C. Acquah, the Executive Director of the EPA, to address the fragmentation of the current environmental laws, the EPA is assembling pieces of legislation relating to the environment together to enable it to draft a more comprehensive bill on environmental protection which would facilitate administration and implementation of environmental laws (*Ghanaian Times*, 16 August 1995).

SUSTAINABLE DEVELOPMENT, POPULATION AND ENVIRONMENT

The World Commission on the Environment and Development (1987) report on *Our Common Future* notes the increasing strain between the environment and economic development, and calls for sustainable development as a reasonable means to achieve political, social and ecological stability. The report defines "sustainable development" as development that meets "the needs of the present without compromising the ability of the future generations to meet their own needs" (World Commission on the Environment and Development, 1987:43). It argues that a healthy and peaceful society cannot be achieved with widespread poverty and environmental degradation

Sustainable development requires meeting the basic needs of all people and extending to everybody in both present and future generations the opportunity to satisfy their aspirations for a better quality of life. In developing countries including Ghana, however, the majority of the people cannot meet their basic needs and yet have legitimate aspirations for an improved life (Agius, 1993). According to Brundtland (1987), these countries are caught in a vicious circle of economic decline, increasing poverty and environmental degradation. The international system - characterised by falling commodity prices, debilitating burdens of debt, high interest rates, declining financial flows and reduction in aid - has forced developing countries to overtax their environment in order to pay for imports and accommodate creditors. Thus, the existence of growing poverty and inequity in these countries is largely responsible for the present ecological, social and political crises. Poverty is both a cause and an effect of environmental degradation (Brundtland, 1987).

The June 1992 United Nations Conference on Environment and Development (dubbed the "Earth Summit") held in Rio de Janeiro, Brazil, emphasised essential issues relating to development, underdevelopment, poverty and environmental degradation in the developing countries (Hardoy*et al.*, 1992). These issues include diseases, pollution, high rates of population growth, and unsustainable patterns of production and consumption.

Poverty, as a factor of environmental degradation, is closely tied to population. According to Chambers (1994:3), "higher population increases poverty, poverty leads to

higher population, poverty is bad for the environment, increased population is bad for the environment and environmental deterioration contributes to poverty". The population-environment nexus is complex (Hansen, 1992) and has given rise to different interpretations. The neo-Malthusian approach focuses on the concept that population growth is a major cause of resource depletion as a society struggles to feed its rapidly growing population. The growth of human population has inevitably led to the destruction of natural habitats and the reduction of biodiversity (Sadik, 1991). Alternatively, Boserup's (1965) perspective argues that population growth causes agricultural change by intensifying land use and increasing land productivity, initially through shortening fallow periods and later through technological improvements. While the neo-Malthusian approach sees natural resources as finite, Boserup sees technological innovation as the mediating factor between increasing population densities and resource conservation. Harrison (1992) attempts to reconcile these two competing approaches in the context of waste disposal, arguing that the environmental "crisis" is not one of resource shortages, but resource waste requiring better resource management. Population, technology and consumption each produces waste and each uses the natural world as a sink, thereby contributing to environmental degradation (Hansen, 1992; Harrison, 1992).

Cruz (1996) contends that since biodiversity depletion is caused by multiple and complex factors, all of which are interconnected: the effect of one cannot be separated from one another. One way of looking at how these factors interact is to trace the linkages between the nexus of population growth, poverty and environmental degradation. For example, a particular form of population growth - the migration of people into biodiversity protection sites - is viewed as a complicated response to various influences, including national population increase, lack of economic opportunities and unfair distribution of agricultural lands. Deepening poverty among rural farmers adds to other factors that are already propelling the landless into fragile lands and coastal areas.

The World Bank's Africa-region *Nexus Project* which examines the relationships between rapid population growth, environmental degradation and poor agricultural performance in 41 countries in Sub-Saharan Africa presents three important results: (a) the availability of cultivable land per person is significantly lower than the rate of population; (b) agricultural intensification, through greater use of fertilisers, increases crop yields at rates higher than the growth rates of population and reduces deforestation rates by almost three per cent per annum; and (c) a population growth rate exceeding 2.5 per cent per year increases deforestation or land degradation by 1.5 per cent per year (Cruz, 1996).

In sum, the above discussion suggests that the combined effects of poverty, a low level of technology and a high population growth rate such as that of Ghana's at 2.6 per cent (Statistical Service, 1989) are inimical to the twin goals of sustaining development and a healthy environment.

THE STUDY AREA

The three communities studied in this paper are New Amanful, Funkoe and Adjuah, all located on the eastern coast of the Ahanta West District of Ghana about seven to 12 km away from the twin-city of Sekondi-Takoradi, the capital of the Western Region (Figure 1). The study area exhibits various landforms including headlands, cliffs and areas where coastal lagoons are separated from the sea by littoral barriers. The principal drainage basins are made up of River Whin, Enya Lagoon and Dadowa Lagoon (Figure 2).

The three communities have relatively low or negative population growth rates (Table 1)

as compared to the national population growth rate of 2.6 per cent per annum. Farming and fishing, the main economic activities of these communities, are seasonal in nature and carried out on a small-scale basis. During the off-season, most of the people are unemployed. About ten per cent of the population have permanent jobs in the regional capital of Sekondi-Takoradi while another five per cent engages in sand mining, usually during the off-season. Sand mining in the study area dates back more than four decades. It is not confined to the three communities but also involves those residing in nearby settlements such as Apowa, Apremdo, Kwesimintsim, New Takoradi and Takoradi.

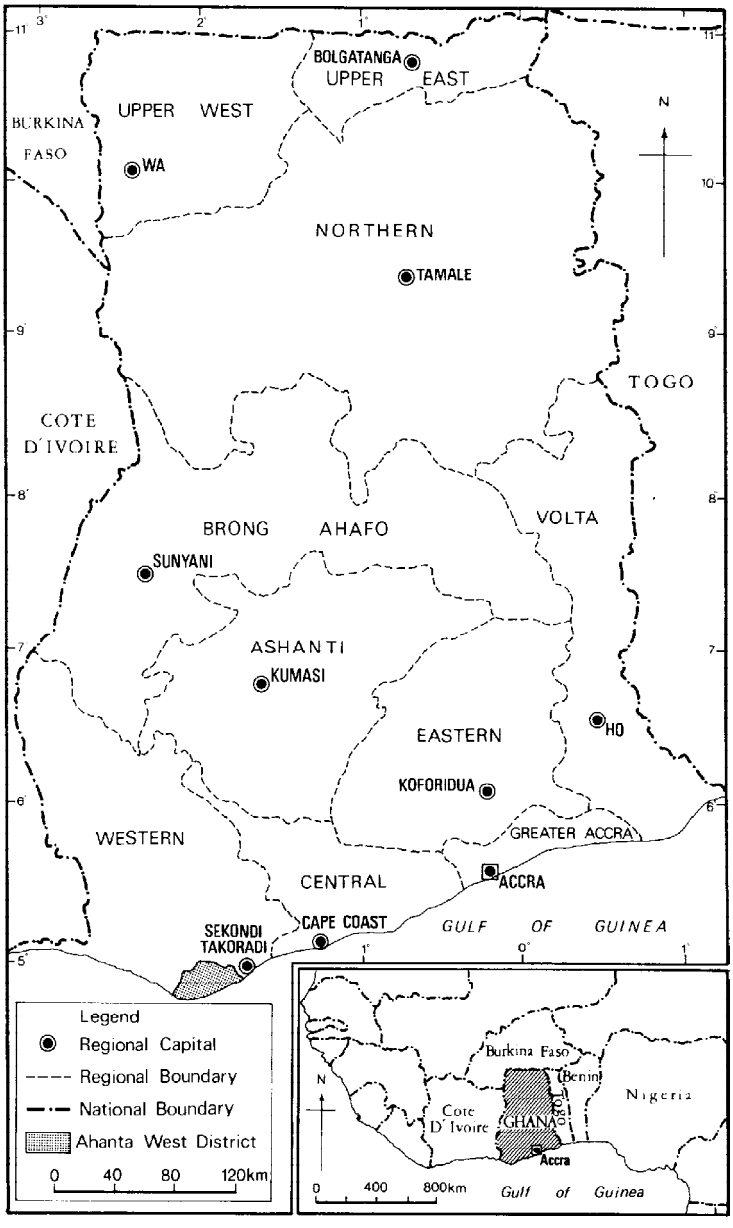

Figure 1. Ahanta West District in Ghana.

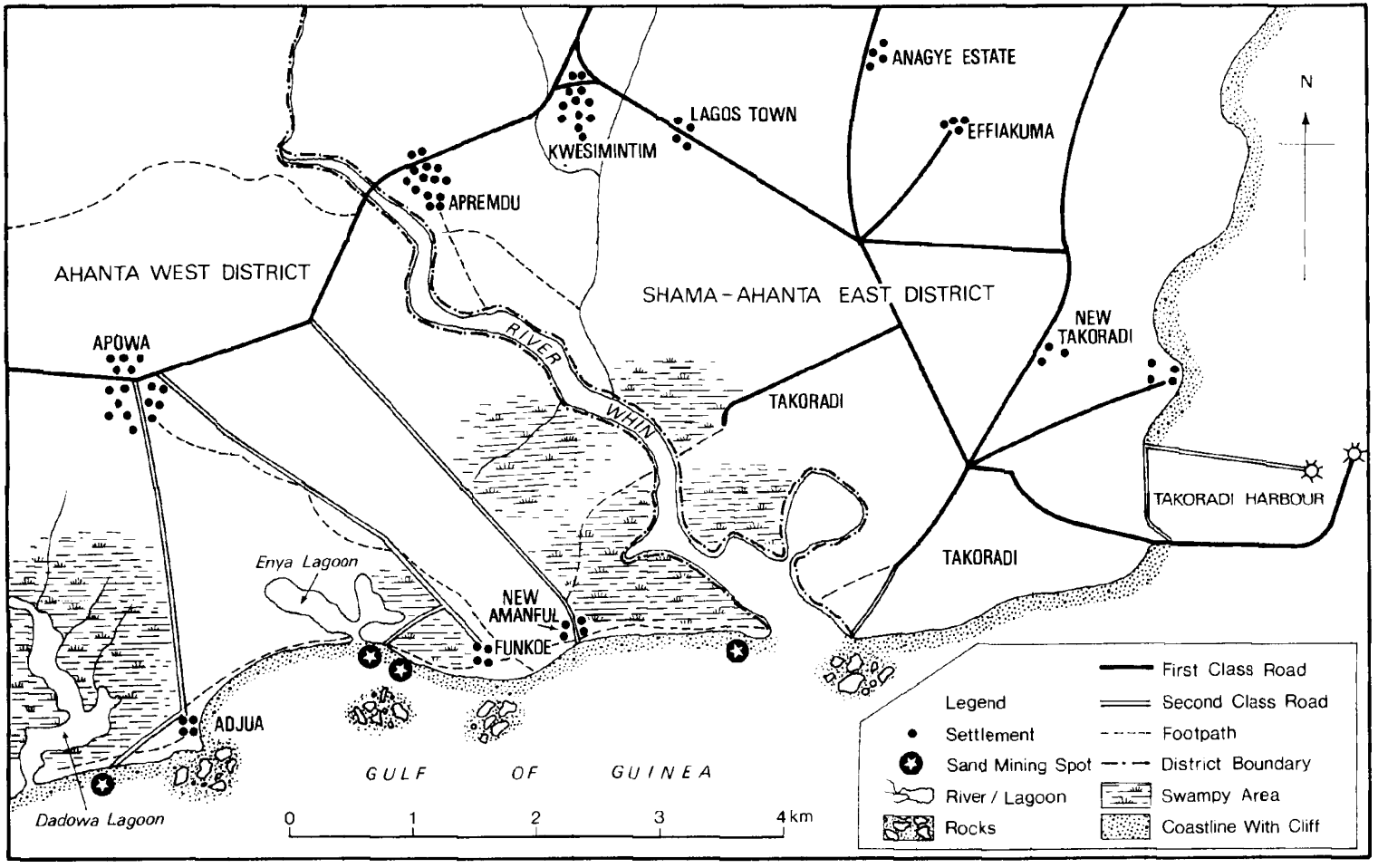

Figure 2. Eastern coast of Ahanta West District.

TABLE 1. POPULATION SIZE IN SAND MINING COMMUNITIES

COMMUNITY	POPULATION			GROWTH RATE (%)
	1970	1984	1994*	1970-84
New Amanful	767	718	680	- 0.5
Funkoe	1,140	1,107	1,087	- 0.2
Adjuah	1,128	1,368	1,578	1.4

*1994 populationestimates were calculated by the author.

Source: Statistical Service, Accra (1989:11).

METHODOLOGY

Data collection

Data on sand mining practices and environmental conditions in Ghana were gathered from the three sand mining communities of New Amanful, Funkoe and Adjuah. The primary data collection techniques used were participant observation, interviews and focus group discussion. Observation was employed at sand mining sites to gather data on the techniques and implements employed in mining sand and the extent of environmental degradation. Interviews using structured questionnaires solicited information on labour organisation, the reasons for engaging in sand mining, damage to the physical environment and the socio-economic problems associated with the activity.

A multi-stage sampling technique consisting of quota and simple random sampling was adopted to select the various groups of sand miners and non-sand miners (people not directly involved in sand mining) as interview candidates. The sand miners consisted of sand carriers, sand loaders and tipper truck drivers while the non-sand miners were made up of teachers, community members, chiefs and other community leaders. The sand contractors who constitute the fourth category of sand miners were not available on site for interview. Efforts made to contact them in their offices proved futile.

At each of the three sand mining spots, five sand carriers, five sand loaders and two drivers were randomly selected and interviewed (Table 2). In each community, the Assembly person or chief, an elder, two teachers, three members of the Village Development Committee and ten other residents (community members) were also interviewed. The teachers were deliberately selected to elicit their opinions on the activity and to investigate how they create awareness among school children and community members regarding the relationship between human activities and the environment. Given the rural nature of the study area, 70 per cent of the community members selected for interview were farmers, fishermen and fishmongers. Normally, these people participate in both fishing and farming activities concurrently. The ratio of the female to male community members was 2:3.

Basically, the activity is gender specific: the sand carriers are women while the sand loaders and drivers are men. Thus, with regard to the sand miners interviewed, the ratio of female to male was 5:7. The number of sand miners interviewed represented about 40 per cent of the total sand miners in the three communities. The ratio of female to male respondents with respect to non-sand miners was 1:2 and the

TABLE 2. TYPE AND NUMBER OF RESPONDENTS

TYPE OF RESPONDENT	NUMBER
Sand miners	
Sand carriers	15
Sand loaders	15
Drivers	6
Sub-total	*36*
Non-sand miners	
Teachers	6
Chief and other community leaders	14
Community members	30
Sub-total	*50*
TOTAL	86

Source: Field data, May 1993.

total number formed about two per cent of the total population. The views of non-sand miners were further sought through focus group discussions.

Different questionnaires were administered to the sand miners and the non-sand miners. For the former, issues emphasised included processes of sand mining, labour organisation, income levels, sources of income, causes and effects of sand mining and suggestions to solve the problems, if any. Issues in the questionnaire addressed to non-sand miners related to the causes and effects of sand mining, local rules and regulations concerning sand mining, the community developmental problems, the priority projects and the sources of finance for implementation.

Apart from observation and interviews, focus group discussions in each village were conducted to solicit information on the main development problems faced in the area, community projects under implementation, sources of funding, factors promoting sand mining and other associated problems. For these discussions, the community was divided into three groups of people, *viz.*, men, women and community leaders. Simple random sampling was used to select members with similar socio-economic backgrounds. Observation, interviews and focus group discussions were carried out by the author and two field assistants in 1993.

To ascertain the extent to which the coastline had retreated, the shorelines were measured once every four months between February 1992 and January 1993, using the main rocks on the beaches as reference points. A mean rate of about 2.1 m per year with standard deviation of 0.6 m was found. To cross-check the measurements, participants of the focus group discussions were also asked to identify the levels of the shoreline in 1983 (the year characterised by drought and hunger in Ghana) and 1993 using the main rocks as reference points.

CAUSES OF SAND MINING

Socio-economic factors are the main reasons why people mine sand and pebbles for sale. These factors are discussed below.

Lack of adequate employment

Unemployment and underemployment compel people to become sand carriers, loaders and tally clerks in order to make ends meet. Of the 36 sand miners interviewed, about 19 per cent of the respondents had no job apart from sand mining (Table 3). The remaining 81 per cent had other jobs such as fishing, farming and petty trading and used sand mining(including driving) to supplement their living. All the 50 non-sand mining respondents also mentioned the problem of inadequate employment as a factor responsible for sand mining.

The agricultural sector is not lucrative due to high input costs, high risk and inefficient traditional methods of production. Fertilisers

TABLE 3. EMPLOYMENT STATUS OF SAND MINERS

EMPLOYMENT STATUS	SAND CARRIERS		SAND LOADERS		DRIVERS		TOTAL	
	No.	%	No.	%	No.	%	No.	%
Have other jobs	12	80.0	11	73.3	6	100.0	29	80.6
Have no other jobs	3	20.0	4	26.7	0	0	7	19.4
Total	15	100.0	15	100.0	6	100.0	36	100.0

Source: Field data, May 1993.

and seedlings are expensive. An outbreak of the Cape Saint Paul Wilt disease in the study area since 1985 has killed the remaining coconut trees that did not suffer from the effects of sea erosion. The situation has eroded the economic base of coconut farmers and those engaged in related activities such as oil processing and farm labour who represent nearly 15 per cent of the total population. The coconut industry has provided local communities with employment, coconut fruits, oil, husks for fuelwood and brooms, sticks for smoking fish, and materials for building and handicrafts. In fishing, inputs (especially nets, canoes, outboard motors and petrol) are expensive and beyond the purse of many fishermen. Fishing is also a risky enterprise in the sense that strong ocean currents and big fishing trawlers often sweep away the nets of the small-scale fishermen. Furthermore, the lack of electricity and potable water makes it difficult to enter small businesses like pig and poultry rearing, cold store, polythene bag packaging, mechanised carpentry and dressmaking. Sand mining provides an alternative means of survival with relatively few entry barriers.

High profit accruing to sand contractors

Another factor that promotes uncontrolled sand mining is the high profit accruing to sand contractors. Compared to the national minimum daily wage rate of US$1.22 in 1993[1], a contractor made a minimum net profit of US$55.47 per day, while a sand carrier and loader made a daily net income of US$1.54 and US$2.16 respectively. The high profit margin to contractors may be explained by the high demand for sand and stones coupled with limited alternative sources of building inputs such as landcrete and river sand.

The construction industry in southern Ghana relies heavily on coastal sand and pebbles. The demand for sand and stones is caused by high demand for housing and construction works in nearby urban centres. Since 1987, the relative importance of mining, quarrying and construction has increased in Ghana while the contribution to the industrial sector of manufacturing has declined (ISSER, 1994). Today, the growing urban population has accelerated the construction of houses and business premises on lands that were hitherto unoccupied in areas like Lagos Town, Effia-Kuma, Tanokrom and Anagye Estate. Between 1970 and 1984, these areas registered population growth rates ranging from 3.7 per cent to 10.1 per cent per annum as compared to the national growth rate of 2.6 per cent (Statistical Service, 1989).

Easy access to the coast

Sand contractors, carriers and loaders have easy access to coastal materials with little or no regulation from the central government, district authorities or traditional rulers. The contractors, whose main business is to cart away sand and stones to maximise profit, do

[1]The official exchange rate in 1993 was 649.00 cedis=US$1.00.

not take into account the environmental hazards. As Thring (1995) has observed, success is often judged by the maximisation of profits rather than the number of people who have suffered along the way, the general level of satisfaction of the people, or effects to the ecosystem. It is easy for a contractor to obtain a licence and permission from government agencies and traditional rulers to mine sand and pebbles because first, there are no land use regulations on the beach and coastal sand is accepted by all as a communal property with the traditional authorities as trustees; and second, the low cost of implements used for mining enables easy entry into the activity; all a sand carrier needs are a head pan and a shovel.

Low environmental concern

Overall, there is little concern for the sustainability of the fragile coastal environment for both the present and future generations[2]. Although the respondents (both sand miners and non-sand miners) knew that sand mining causes coastal erosion, more than 55 per cent of them were not concerned about the chain of consequent hazards caused to other natural resources such as plants, animals and wetlands. They readily mentioned coastal erosion (loss of land) as the only effect of sand mining. It was only upon further probing that other effects such as loss of plants and animals, loss of beaches for sports and landing sites for canoes, destruction of properties and access roads, and social disputes were noted. Similarly, it was during focus group discussions that participants were made aware that the effects of sand mining go beyond the loss of land, and include the destruction of plants such as coconut trees, cacti, palm trees, raffia palm, mangroves and shrubs along the coast, while driving animals including monkeys, squirrels and grasscutters inland. Thus, the lack of concern stems in the first instance from low levels of environmental awareness. In fact, the sand miners have a picnic song which implies that because coastal sand and stones are the gifts of nature and have no monetary costs, they are open to exploitation by humankind:

We should be happy and rejoice
For sand, we don't buy before we carry.
It is free of charge!
Let's go to our master's home
And entertain ourselves.

Keating (1994:36) notes that "many people do not understand the close ties between human activities and the environment because they have inaccurate or insufficient information". Low environmental concern may be attributed to the low level of environmental education and limited number of community organisations with an interest in the environment.

High community desire for development projects

Facilities in the three communities under study are woefully inadequate (Table 4). Rural dwellers are generally of the opinion that the government has given little or no attention and support to rural areas, even in the study communities which are within 12 km of the regional capital. Given such limited amenities, rural dwellers have taken it upon themselves to undertake development projects - including the provision of electricity, potable water and basic school and health facilities - to modernise their communities. Sand mining is a major source of funding for such projects. Adjuah was able to finance its electrification and water projects by undertaking communal sand mining and is currently implementing a nursery school project. Funkoe adopted Adjuah's strategy of communal sand mining and has been able to procure some electric poles, electric bulbs and extension wires. The residents of New Amanful organised a communal harvest to raise money while the proceeds from sand mining went to the traditional authority.

[2] This finding is quite different from Baker's (1995:85) observation that "farmers are normally ecologically aware".

TABLE 4. DISTRIBUTION OF FACILITIES BY COMMUNITY

COMMUNITY	FACILITIES
New Amanful	Primary school, untarred road
Funkoe	Primary school, untarred road
Adjuah	Primary school, untarred road, pipe-borne water, electricity

Source: Field data, May 1993.

EFFECTS OF SAND MINING

Both sand miners and non-sand miners ultimately recognised that the main effects of uncontrolled sand mining include loss of land (19.2 per cent), destruction of beach (18.2 per cent), destruction of road (16.5 per cent), land conflict (13.7 per cent), loss of vegetation (12.2 per cent), destruction of property (11.8 per cent) and use of child labour (8.4 per cent) (Table 5).

Loss of land and destruction of property

Erosion has resulted in significant loss of coastal land. The shoreline of eastern coast of Ahanta West District has retreated about 21 m inland over the past decade, i.e. an erosion rate of about 2.1 m per annum. This confirms the belief of the EPC (1991) that there are some unknown areas in Ghana where the rate of erosion exceeds 1.5 m per annum. Biney*et al.* (1993) observes that rates of coastal erosion in the Greater Accra Metropolitan Area of Ghana exceed 2 m per year at critical areas such as Labadi.

Many private and community properties including houses, footpaths, farmlands, pipelines, cemeteries and church buildings located on the coastline have been destroyed. These problems have resulted in social disputes particularly between the current and prospective victims whose properties have

TABLE 5. PERCEIVED PROBLEMS CAUSED BYUNCONTROLLED SAND MINING

EFFECTS	SAND MINERS n = 36		NON-SAND MINERS n = 50		TOTAL n = 86	
	No.	%	No.	%	No.	%
Loss of land	30	25.2	50	16.8	80	19.2
Destruction of beach	28	23.5	48	16.1	76	18.2
Destruction of road	21	17.7	48	16.1	69	16.5
Land conflict	11	9.2	46	15.4	57	13.7
Loss of vegetation	18	15.1	33	11.1	51	12.2
Destruction of property	5	4.2	44	14.8	49	11.8
Use of child labour	6	5.1	29	9.7	35	8.4
TOTAL	119	100.0	298	100.0	417	100.0

Note: The total number of responses exceeds the number of respondents because of multiple responses.
Source: Field data, May 1993.

been or are in danger of being damaged on the one hand and the contractors and some traditional rulers on the other. Cases of social disputes have been reported to the Kwesimintsim police and authorities at both the district and regional levels, and are likely to have contributed to the impounding of nine tipper trucks by the Western Regional Administration on the World Environment Day to stop sand mining at Funkoe (*People's Daily Graphic*, 7 June 1993).

Destruction of beaches

The eastern coast of Ahanta West District used to have a sandy beach with occasional rocks. It has now been degraded into a denuded beach sitting about 2.5 m below an "artificial" cliff (Plate 1). Coastal erosion has also created a stack with a radius of about ten metres and a cliff measuring around three metres along the nearby shore of Nkotompo in the Shama-Ahanta East District which is 20 km east of the eastern coast of Ahanta-West District. The sand miners create paths and steps by carving through the cliffs to enable them to carry sand and pebbles upland (Plate 2). Such destruction of the beach has led to exposure of rocks which pose danger to landing canoes. It has also reduced the scenic beauty of the beach which used to attract visitors and tourists, and limited the playing ground for soccer and horse racing. It appears that the headland at Adjuah is becoming thinner and thinner as a result of erosion.

Destruction of roads and land conflicts

Sand tipper trucks have caused considerable destruction to community roads, including the creation of pot holes and the collapse of

Plate 1. A cliff and coconut trees that are attacked by erosion and the Cape Saint Paul Wilt Disease. The disease has caused the leaves of the trees to turn yellowish-brown.

culverts. The roads leading to sand mining spots (i.e. used by tipper trucks) are in such a deplorable state that in the rainy season, they cannot be used by smaller vehicles such as cars. The destruction of roads in turn has damaged vehicles, reduced the flow of passenger vehicles, increased the maintenance costs of road and resulted in social disputes. In the late 1970s, the people of Adjuah banned tipper trucks from using their road. In Funkoe, there have been many instances when the residents have come into conflict with sand contractors over the use of the road linking Funkoe and Apowa.

Loss of vegetation

Another effect of sand mining has been the loss of vegetation. The resultant coastal erosion has eliminated many species of vegetation such as mangrove, cacti, raffia palm and coconut trees. Erosion, sand mining and the Cape Saint Paul Wilt disease have contributed to an 80 per cent decline of coconut and other vegetation over the last 40 years (Biney *et al.* 1993). Sand miners have cleared the vegetation to make room for the collected sand and pebbles. In carting away coastal materials, trucks have destroyed some plants. Beyond the reduction in scenic beauty, related effects include a declining stock of fish and crustaceans in the rivers and lagoons, and a reduction in food production. About 82 per cent of the 50 non-sand miners interviewed indicated a decline in fish caught in the river and lagoons in recent years.

A road through the Enya wetland to the beach was constructed on land reclaimed from the lagoon, contributing to the dwindling size of the lagoon and its wetland. According to Turner and Jones (1991), scientists have demonstrated a direct relationship between the existence and size of tidal wetlands and

Plate 2. A path and steps carved by sand miners near the Enya Lagoon. A sand loader (arrowed) and three interviewers are in the foreground.

estuaries and the production of marine shrimp. The removal of sand (which hitherto served as a barrier between the sea and the lagoon) at the mouth of the Enya lagoon has allowed sea water to flow into the lagoon at high tide, and lagoon water into the sea at low tide. Coastal erosion has also washed away land suitable for the cultivation of crops such as tigernuts, groundnut and shallots. This has created a fall in the production of these crops in the study area.

Use of child labour

Some of the women who are sand carriers engaged their children and relations below the age of 14 years to assist them. Four (26.7 per cent) of 15 women interviewed indicated that they received assistance from their children in carrying sand at the weekends and school vacations, while one engaged her children throughout the entire period of carrying sand. The remaining ten (66.6 per cent) did not receive any assistance from the children. Not only is the work taxing (a headload of either sand or pebbles weighs approximately 40 kg), it is also related to frequent truancy from school.

CAUSE-EFFECT RELATIONSHIP OF SAND MINING

The cause-effect relationship of uncontrolled sand mining in the study area is illustrated in Figure 3. As already discussed, immediate causes of uncontrolled coastal sand mining are the lack of adequate employment, easy access to the coast, high profit for sand contractors, high community desire for development projects and low environmental concern. Beyond these are intermediate causes which include low education levels, the non-lucrative nature of agriculture, a lack of small-scale enterprises and easy access to a licence by sand contractors. The root causes of these problems are the high input costs and risks in agriculture, inefficient traditional methods of farming and fishing, high demand for housing, insufficient research on alternative building materials, fear of intimidation by sand operators and corrupt politics.

The immediate effects of uncontrolled sand mining include the loss of beaches, vegetation and land, destruction of roads and use of child labour. Secondary effects include poor landing sites for canoes, a reduction in scenic beauty, social disputes and damage to vehicles.

The cause-effect relationship as revealed by this study supports Hansen's (1992:124) contention that "a complex interaction between ecological, physical, demographic, social, political and economic factors determines the form of settlements and their impacts on the natural resource base".

RECOMMENDATIONS

A healthy coastal environment is not a luxury but a necessity for coastal communities. The recommendations made as a result of this study are based on several principles. First, policy makers and the local people have the enormous task of protecting the environment. This requires intersectoral co-operation and community participation in the management of the coastal environment. Second, a sound coastal management can only come about if there are serious planning effort and clear political thinking. Third, the provision of basic needs, poverty alleviation, the raising of economic well-being of the people, and improved technology will reduce the reliance on sand mining. Fourth, dealing with coastal crises requires new scientific knowledge, new engineering and technology as well as new practices and methods. Based on these principles the following recommendations are made:

Increasing employment opportunities

Agriculture and fishing should be made lucrative. This involves the introduction and extension of improved modern production techniques that are affordable to both farmers

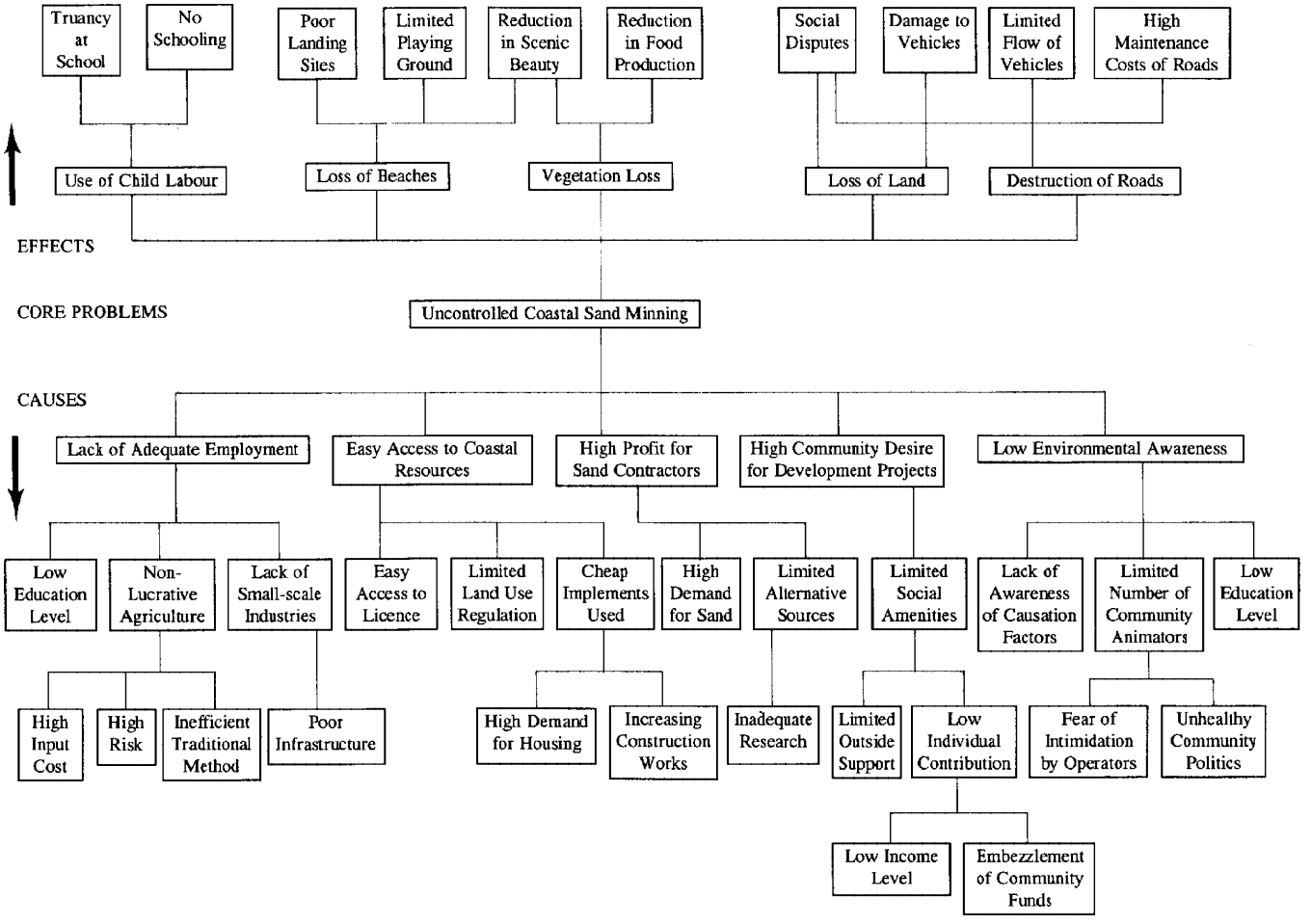

Figure 3. Problem tree diagram of uncontrolled sand mining.

and fishermen. Finding a cure for the Cape Saint Paul Wilt disease is essential. Research into the disease is urgently needed. In addition, small-scale fishermen should be protected from the harmful activities of fishing trawlers. The government should enact and enforce a law that would prevent trawlers from encroaching on in-shore waters. Furthermore, the promotion of small-scale enterprises such as carpentry, piggery, poultry, cold store and dressmaking is necessary. This implies that an enabling environment should be created through the provision of basic facilities like electricity, potable water, credit and better access roads. There is also the need to provide entrepreneurial and technical skills to the rural people. This strategy supports Cruz's (1996) view that in managing biodiversity, relevant programmes must be designed to address local needs.

Use of gabion groyness and rubble mound revetments and vegetation stabilisation

The EPC (1991) believes that the success of protection works along the coast has been limited and engineering options cannot provide long-term solutions to coastal erosion. In the short-term, however, gabion groyness and rubble mound revetments have been used to control coastal erosion in Ghana quite successfully (Biney, *et al.*, 1993; *Ghana Television (GTV)*, 30 December 1996 and 2 January 1997). But, according to Biney*et al.* *(*1993), groyness and revetments are expensive and once constructed, hinder the opportunity for a beach to form, a matter of relevance to tourism investment in terms of the attraction of coastal resorts. They therefore suggested vegetation stabilisation, *viz*, planting vegetation species including the coconut palm (*cocos nucifera*), India almond (*Terminalia catapia*) and sporobolus (*Sporobolus vaginatum*).

It is argued here that the use of coconut palm would be limited unless a cure for Cape Saint Paul Wilt disease is found. Other alternatives need further research by engineers and scientists to identity the most cost effective and efficient system of protecting the coastal environment.

Regulating sand mining

In view of the grave environmental damage done to the coast, the central government and district authorities should regulate the activities of sand miners. Biney*et al.* (1993:122) state that "the removal of sand, pebbles and rock aggregate from all beaches should be prohibited". With the recent recognition that human activity need not necessarily be incompatible with nature and that local people need to derive benefits from protected areas if they are to be expected to support conservation efforts (McNeely & Miller, 1984; Western & Wright, 1994; McNeely *et al.*, 1994), it is argued here that sand mining cannot be banned completely as suggested by Biney*et al.* (1993). Instead, only local communities should be allowed to utilise sand to build houses until such time as the coast has been assessed to have regained healthy environmental conditions. When sand mining is re-activated on a commercial basis, licences or permits should be given only to contractors who are able to prepare Environmental Impact Assessments or proposals to demonstrate their competence, technological know-how and access to equipment to deal with coastal environmental damage. Activities of contractors should be closely monitored and evaluated to ensure effective and efficient implementation of the regulatory strategy.

Politicians and administrators should not pay lip service to environmental concerns like sand mining. District authorities and traditional rulers must look beyond financial concerns to consider environmental damage. On 5 June 1993, as part of observing the World Environment Day, the Western Regional Administration organised a task force and impounded nine tipper trucks carrying sand that destroyed the coastal environment of Funkoe (*People's Daily Graphic*, 7 June 1993). After that day, the tipper trucks continued their activities as usual. In any

instance, the Ga South District Administration sold tickets to the sand miners as a means of earning some revenue and providing employment (*People's Daily Graphic*, 11 June 1993). It is injudicious and short-sighted to sacrifice the ecosystem for short-term financial and economic objectives (McNeely & Ness, 1996).

Research into alternative input sources

Intensive research into alternative input sources for the construction industry is needed. This implies that governmental and inter-governmental institutions, non-governmental organisations and individuals should put resources together to find viable and sustainable sources of raw materials required for the construction of houses, factories, bridges and roads without depending too much on coastal sand and pebbles. Participatory research - in which all actors in the quarrying and construction sectors provide inputs to develop technologies that are relevant, useful and acceptable to a sound environment - is needed. This requires workshops, seminars, study tours and community meetings. Building on indigenous technologies, improved technologies could be developed that would contribute to sustainable development (Keating, 1994; Monu, 1995). For example, the technologies used to build traditional mud house could be improved to make them more acceptable to people. Local people and foreign experts should work together to combine knowledge, skills and resources to find practical solutions to poor environmental practices.

Increasing environmental awareness

A change in attitudes is required for successful implementation of a coastal management strategy. In this light, environmental education is very important for it "can give people the environmental and ethical awareness, values and attitudes, skills and behaviour needed for sustainable development. To do this, education needs to explain not only the physical and biological environment, but the socio-economic environment and human development" (Keating, 1994:36; see also EPC, 1991; Biney, 1993; Cruz, 1996). Continuous and detailed public education programmes on the coastal environment should be formulated and implemented at all levels, from the national to the local. Essentially, the programmes should raise environmental consciousness of the problems and fragility of the coastal environment and stress the vital nature of responsible action.

Ghana's President, J.J. Rawlings, has observed that Ghana's environmental sustenance campaigns can be successful only when educational programmes are combined with effective enforcement of environmental laws. He further stated that both law enforcement agencies and the media should be made an integral part of the campaign for sound environmental awareness campaign. While the Ministry of Environment, Science and Technology has included the district and traditional authorities in its environmental education campaign (*Daily Graphic*, 16 August 1995), the media, including print, radio and television, must intensify their activities to feature the opportunities of and problems facing the coast. According to Thring (1995), television programmes should act as a "third parent" by providing information and creating awareness among local communities of how other people live and other landscapes.

Intensification of population control programmes

Sustainable development requires a balance between population and the carrying capacity of coastal areas. Rapid population growth often calls for more houses, roads and bridges which stimulate high demand for coastal sand and stones. Therefore population growth needs to be contained. Family planning campaigns and rural development should be intensified to encourage people to adopt smaller family sizes. Rural development programmes to help rural youths find local employment would also help to control out-migration to the coastal urban areas.

Encouraging participation in community-based activities

Communities should adopt a participatory planning and decision-making approach. When people are directly involved in planning and decision-making processes, they will be willing to contribute (both in cash and in kind) towards the implementation of community projects. Community leaders and the staff of district administration and sector departments should be trained in participatory methodologies through workshops, seminars and field work so that they can relate with communities effectively. The collaboration of all development actors towards local level development is highly recommended. Another aspect of encouraging community participation highlighted by Cruz (1996) is the use of participatory management and negotiations resolve conflicts.

Individual financial contributions toward community development projects could be enhanced when the community leaders give regular and genuine financial reports to the members. For instance, in over the five years before this study, community leaders of the study communities did not render accounts of the revenue and expenditure of the community. In 1993, the leaders of the Village Development Committee in Funkoe rendered accounts but the people were not satisfied because the accounts were full of inconsistencies. The issue was referred to the Ahanta West District Administration for resolution. The people vowed not to pay any development levy until proper accounts were submitted.

CONCLUSION

According to Baker (1995:86), "the sustainability of any ecosystem depends on the input more or less balancing the output". What is being witnessed in the eastern coast of Ahanta West District of Ghana is a growing imbalance as prevailing uncontrolled sand mining continues to cause significant coastal environmental damage and socio-economic problems. A complex interaction between economic, demographic, social and political factors encourage people to engage in the activity. The main economic factors are inadequate employment and the high profit made by contractors. The social factors include easy access to the coast, high community desire for development projects and low environmental awareness. Provision of off-farm employment opportunities, regulating sand mining, research into alternative family planning programmes, increasing environmental concerns and encouraging participation in community-based activities are some of the recommended strategies to overcome the problems associated with uncontrolled coastal sand mining. The solutions require a concerted effort by all development agencies including decision-makers, organisations, institutions, contractors, traditional rulers and local residents. Without monitoring and evaluation, the proposed strategies will not be effective and efficient in ensuring coastal environmental management. Human beings must fulfil their basic needs, improve their living standards and at the same time better protect and manage coastal resources. Dealing with coastal crisis for sustainable development requires new scientific knowledge, new engineering, technology and practices drawn from a number of fields from the mining industry to town planning and resource management. As suggested by Keating (1994), development strategies will have to deal with the combination of population growth, the health of the ecosystem, technology and access to resources. Development plans have to address such needs as food security, basic shelter, essentials services, education, family welfare, environmental care and employment. Positive actions are needed now because continued disregard for coastal environments will inhibit the prosperity and well-being of present and future generations.

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