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Publication date:
2000

Document Version
Publisher's PDF, also known as Version of record

Link to publication from Aalborg University

Citation for published version (APA):
Muchie, M. (2000). *The Uptake of Environmentally Sensitive Innovation in Production in Sub-Saharan Africa*. Institut for Historie, Internationale Studier og Samfundsforhold, Aalborg Universitet.

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DEVELOPMENT RESEARCH SERIES
RESEARCH CENTER ON DEVELOPMENT AND INTERNATIONAL RELATIONS (DIR)

WORKING PAPER NO. 88

INSTITUTE FOR HISTORY, INTERNATIONAL AND SOCIAL STUDIES AALBORG

Research Center on Development and International Relations (DIR)
Aalborg University
Denmark
Development Research Series
Working Paper No. 88

ISSN 0904-8154

Published by
DIR & Department of Development and Planning
Aalborg University

Distribution
Department of Development and Planning
Secretariat, room 36
Fibigerstraede 11
DK-9220 Aalborg East
Phone + 45 96 35 84 19
Fax + 45 98 15 65 41

Lay-out and wordprocessing
Anette Baek

Print
Uni-Print and Centertrykkeriet, 2000

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The Uptake of Environmentally Sensitive Innovation in Production in Sub-Saharan Africa

Mammo Muchie[1]

Abstract:

The objective is to identify empirically the degree to which firms in Sub-Saharan African countries have experience with environmentally sensitive technology uptake. Examples are sought from reports of cleaner production activities from Tanzania and Zimbabwe. Invariably cleaner production is externally induced. It is not created internally as part of a firm's common sense, routine or set of activities. From the technology to the consultants, they seem to have originated from outside. The barriers to the uptake of ESTs into African firms will be identified and the wider context for and ideas for their internalisation to enhance firm capability of environmentally anchored production requires the synchronised deployment of national policy framework, industrial policy, technology selection and production.

Key words: cleaner innovation in production, environmental technology transfer, Tanzania, Zimbabwe, ecological industrialisation

1. INTRODUCTION

One factor for focusing on cleaner production practices in Africa is the possibility of building in environmental matters in Africa's quest to industrialise. In comparison to the industrialised countries, the industrialising countries of Africa can be seen as 'a green field economic space'. The condition for setting up cleaner production centres to help design and plan both an environmentally and economically sound industrial systems is open in Africa. The fact that Africa has no locked up industrial system is a plus in the sense that it does not have to pay the huge costs to readjust and retool massive industrial structures built over many years. It is possible that national environmental laws could enforce the requisite regulatory regime to combine environmental planning with a wealth-creation planning in Africa's relatively more agrarian setting than in industrialised countries.

Planning international technology transfer in the form of environmentally sound technologies (ESTs) uptake into African firms is therefore an important strategy

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to combine development with poverty reduction and environmental security. African development should and can proceed by internalising environmental constraints. There is no alternative to imagine and design strategies to bring about development with environmental health and conservation. A new model of industrial evolution can be tried in Africa. An important factor to the input of African industrialisation is an unfailing thought, consideration and incorporation of environmental constraints. An important output is measurable gains in environmental conservation. Thus theories, concepts and production activities for facilitating Africa's industrialisation have to be more exploratory and imaginative.

The attempt to introduce ESTs into African firms can be seen as starting a break with known patterns of industrialisation. The cases will be examined as part of the search to reveal any light on the alternative road of ecological industrialisation. We shall examine the conception and practice of ESTs uptake in Tanzania and Zimbabwe from reports and conversations the writer had with various consultants especially from UNEP/UNIDO involved in cleaner production assessments, mostly as part of the set up of National Cleaner Production Centres (NCPCs). While interpretation and analysis is from this author, the information is taken from reports and notes from interviews and conversations of international UN consultants. Both Zimbabwe and Tanzania have benefitted from the set up of the UNIDO/UNEP assisted National Cleaner Production Centres. The latter has tried to spearhead cleaner production assessments in specific industries by promoting cleaner production practices via dissemination, workshops, training and courses. The Zimbabwean cleaner production centre has been host to the second meeting of the NCPC group of countries. Cleaner production training at the shopfloor for workers has been explored in Zimbabwe. A training programme for future consultants in CP has been developed. Though Cleaner Product Centre-Zimbabwe (CPC-Z) has provided training, it does not certify the training and is seeking assistance from a Norwegian DNV to certify trainees both in companies and as consultants. Companies in Zimbabwe wish to twin with foreign companies to create technology partnerships. CPC-Z is not inserted in any identifiable pattern in Zimbabwe's superstructure for research and development or production. Its current status remains unclear.

2. CASE STUDY OF CLEANER PRODUCTION EXAMPLES FROM TANZANIA

Reports from Tanzania from consultants claim that many industries are uninformed about cleaner production concepts. There are, however, a number of organisations involved in searching for ESTs. Some of these are: the Tanzanian

Industrial Research and Development Organisation (TIRDO), the Commission on Science and Technology (Costech), the Institute for Production Innovation (IPI) and the Institute for Resource Assessment (IRA).

The introduction of cleaner technologies in Tanzania was carried out through a project based on the collaboration of an international donor DANIDA, Government's ministry of Tourism, Natural Resources and Environment, industry, academia and R & D institutions. The project was called Cleaner Environmental Production in Industry in Tanzania (CEPITA), and it was set up with the mandate to:

a) generate a systematic framework for introduction of cleaner production technologies with the aim of waste prevention at source, minimisation of water, chemical and energy consumption within selected industries,
b) demonstrate that economic benefits can go hand in hand with environmental benefits,
c) formulate an effective pollution prevention policy and strategy,
d) train industrial personnel in cleaner production and
e) create cleaner production within government, industry, academia and civil society institutions (Migiro, 1996).

Various reports indicate that Tanzania has experience of cleaner production assessments at a firm level. Twelve companies have been selected for cleaner production assessments at the pilot phase. The sub-sectors from which the companies came were: three in metal and electroplating, one in glass, one in cement, two in food and beverage processing, two in soap, two in textile and one in fibre processing. The companies were Galco, Kioo LTD., Medicare, Tanga Cement Company, Bonite Bottles, Sunflag, Arusha Galvanising Company, Mwanza Voil, Lake Soap, Zana Za Kilimo, Mbeya Textile Mill and Kimamba Fibre Estate (UNEP, 1996). Cleaner production options were considered, a total of 169 options were reported. Out of these 105 were found feasible by the industries and are expected to be implemented. Further feasibility studies have been planned on more industries (UNEP, 1996).

The Cleaner Production Centre of Tanzania has taken over the work of CEPITA. It has been reported to organise demonstration projects on six industries on mainland Tanzania and ten industries on the Zanzibar (UNEP, 1996). The sub-sectors in Dar Es Salaam include cement, electroplating, beverages, iron and steel, and soap/detergents. In Zanzibar, they include food and beverages, essential oils, tobacco, soap, motor repair workshop, fuel transportation/ marketing, and motor trading. The companies in Dar Es Salaam are: Tanzania Portland Cement Co. Ltd., Tanzania Breweries Ltd., Colgate-Palmolive Ltd., National Bicycles Co., Shivji & Sons Ltd. and Motisun Holdings Ltd. Those in

Zanzibar are: Edible Oils, Clove Stem Oil Distillery Plant, Zanzibar Bottles (Coca-Cola Company), Bakhresa Flour Milling Company, Bakhresa Soap Ltd., Motor Trade Corporation and Tractor Repair Workshop (UNEP, 1996).

The demonstration projects provide an enabling environment to identify cleaner production option barriers to implementation, technical feasibility studies and investment costs. The result from the demonstration is disseminated to other companies. In this way best practice is thought to be diffused to more and more firms. The Cleaner Production Centre of Tanzania is supposed to act as a sort of information clearing or resource centre on cleaner production. To date, there is no information on whether CPCT is undertaking technical evaluation to identify and select viable cost effective alternative indigenous technologies to disseminate to companies.

There is very little technology research in Tanzania and almost all technology has to be imported from abroad (Ruijters, 1996). Most of the ESTs appear in the form of end-of pipe treatment, good house keeping, use of waste as a by-product, techniques for eliminating hazardous chemicals and a few production-integrated technologies.

In Tanzania, a number of organisations claim capacities to undertake technology needs assessment and selection. The Clean Production Centre has the explicit purpose to build capacity for identification, demonstration and promotion of knowledge on waste minimisation and cleaner production. The Centre for Energy, Environment, Science and Technology, TIRDO, and Costech claim to make technology assessments. While these institutions say they can assess technology options, industry has to seek out for their help. There is no such voluntary seeking out by industry for information on ESTs (Ruijters, 1996). Some institutional elements, which can serve as a national system of innovation, exist and they need to be strengthened.

If much of the technology is imported externally, pressure for ESTs uptake has to come from the same external sources from which the technology is bought or taken. Those who provide loans to Tanzanian industry are also likely to attach specific environmental requirements as ‘condition’ to their loans. Other routes of ESTs uptake relate to:

- possible benefits accruing to local firms from a parent company or partner which has incorporated ESTs in its production system;
- if legislation on health and safety grounds prevent companies from polluting local areas;
- if cleaner production is found more economical than the dirty production it replaces; and

- if investment costs for introducing cleaner technology will be compensated by higher gains as a result of the uptake of ESTs by firms (Muchie, vol.5, no.1,2000).

Disincentives for EST uptake can be triggered by regulations, consumer and advocacy pressure, legal threats and product boycott. Other measures can act as incentives include clear and measurable gain coming from the introduction of ESTs into firms. When there is value-added gain of efficient production and economic advantage coming on top of environmental gain, ESTs can compete for uptake (Muchie, vol.5, no.1, 2000).

3. EXAMPLES OF CLEANER PRODUCTION ASSESSMENTS IN ZIMBABWE[2]

In Zimbabwe a cleaner production assessment has been undertaken on Zimbabwean sugar refineries (Harare and Bulawayo), and Cairns Foods Ltd. (Harare). The two sugar factories operating under Zimbabwe Sugar Refining Corporation, process 11,000 and 10,000 tonnes of cane per day. They produce raw sugar, white refined sugar and brown sugar. The two sugar factories also operate ethanol plants using final molasses. The problem with the sugar factories is insufficient rainfall. The Harare plant was established in 1953. The main equipment dates back to 1935 and new parts have been added since then. The two factories run seven days a week, twenty-four hours a day and annual throughput is 140,000 and 80,000 tonnes refined sugar for Harare and Bulawayo. The refined sugar is mainly produced for the local market while small quantities are exported to Botswana. The two factories employ just over 300 people, with the main labour force consisting of unskilled labour, technicians comprising a sugar technologist, one for each company, laboratory technicians, and production maintenance supervisors supporting divisional managers. The Harare factory had a production and general manager trained in sugar technology.

At the time of the assessment there was water shortage due to the drought, which hit Zimbabwe (1992-1995). The companies were faced with water rationing. If they exceeded the limits they would be charged higher surcharges. There was thus a need to conserve water. A raw material input of 480 tonnes per day, 225 kg lime per day and 173 kg of phosphoric acid per day and flocculent depending on the pH of the syrup feed and the sugar refining process in the factories. Water and energy are the other inputs. The process goes from the stage of raw material reception, weighing and storage, to batch weighing and

[2] Through extensive conversation with UNIDO /UNEP cleaner production consultants specially from those in IMAM, the University of Amsterdam, the author was able to compile the following case in cleaner production assessments in Zimbabwe's firms.

conveyance, mingling, affixation, centrifugation, melting, screening, clarification, adsorption, evaporation, further centrifugation, drying, storage, packaging and finally into packed sugar.

The areas selected for the audit focus were the following: syrup clarification (de-sweetening clarifiers), colour adsorption (bonechar cisterns), and vacuum evaporation condensate (pans and cooling towers). The reasons for the selection of the problem area are related to the degree of water wastage in the sugar manufacturing processes in the factories. At syrup clarification a lot of fresh water (42 m^3/day) was being wasted to wash scum (335 kg/day) into the sewer system. Wastewater is also generated during the rinsing of cistern for 12 hours estimated at 1512 m^3 per week. Condensate from the evaporation pans is generated at the rate of 28 tonnes/day of which 11 tonnes is lost to drain.

Cleaner production assessments have focused largely upon the technical options, feasibility and financial assessment. For example, technical recommendations to reduce water wastage included:

- installation of water meters to clarifiers;
- diversion of char cistern water as stop gap measures to wash scum;
- recommission of the press filter and reuse of water in the processes;
- at the bonechar cistern recommissions the water softener and re-use water;
- divert excess condensation from evapo-pans for use in processes.

The cleaner production auditors found all these options highly feasible. The cost was estimated at Z$ 300,000 at 14 months for the filter press and water softener.

Another company in Zimbabwe where clean production audit was undertaken was Cairns Foods Ltd. It started as a motor business in 1929 and has diversified into food and beverages in the 70s and 80s. The company employs 1,200 people and boasts of an annual turnover of Z$162 million and Z$228 million in 1994 and 1995 respectively.[3]

The manufacturing process of coffee involves roasting, grinding, weighing, blending, extraction and packaging producing two forms of coffee: ground and instant. With additives these forms can be pure or blended coffee. The inputs are fuel, water, cooking oil, coffee beans and chicory. The process involves roasting, screening and cooling. For ground coffee the process proceeds with weighing, milling, blending and packaging. For instant coffee the extraction proceeds along the line of weighing, meshing, blending, extraction, mixing, filtration, pumping, spray drying, collection and packaging. In the process product loss occurs. Coffee and chicory are roasted and the manner of the

[3] One US$ equals Z$16

roasting normally determines the flavour and blends. Parameters such as temperature, fluids and even the period of roasting are important to control.

The best extraction takes place when temperature, water flow, coffee and chicory mesh is constant. Holding these parameters constant yields higher efficiency, and maximum extraction in a short time, using less energy and waters (yields 60-70% solid recovery. The extraction yields are minimal in the pure blends (35% average) in comparison to coffee and chicory since recoveries for chicory is very high up to 90%.

The selected audit focus was extraction units and spray drying tower. Both were selected because of the poor extraction rates and high waste problems, and high economic losses for the plant. Waste and emissions were in the form of coffee husks sludge and fumes from coffee bean roasting. The plant experiences high economic loss due to low levels of coffee extraction from coffee beans (40-60%) and the generation of large quantities of coffee lumps from the spray drying tower contributing as much as 58%. The cost of such lumps was valued at Z$3million in the plant and warehouse when the clean production assessment began.

For the coffee plant after clean production assessment the following targets were set to:

- Increase extraction rate from the 40-50 % to 60% realising an improvement rate between 10-20%
- Reduce lumps by 40%
- Reduce water consumption by 10%
- Reduce energy use by 20%

The cleaner production technique options suggested were for the extraction units to:

a) add a decanter vacuum filter to press liquor from the coffee waste. This was expected to improve recovery rates without affecting quality at an estimated investment cost of Z$1 million; and
b) fit the flow meter to regulate water intake by extraction units to improve yield concentrations and improve quality at very low cost.

For high-pressure pump units it was proposed to install new pistons to improve pumping pressure of the extract through nozzles for proper atomisation and productivity. Benefits were expected to outweigh costs by 60% due to the reduction of lumps, which will in turn improve plant profits by 40%.

For the spray drying tower, the cleaner production options are fourfold:

a) undo all the welded dampers on air ducts into and out of the spray drying column, improving intake and outflow of hot air in the column at very low cost option carried out during maintenance period,
b) restore all manometers to improve pressure monitoring in the column with a low cost option involving unlocking and cleansing existing tubes,
c) re-alignment of tilted column to improve drying, productivity and quality with a cost option which is neither high nor low to be carried out during the annual shut down, and
d) re-institute the cone height to improve operating parameters in the drying column and expected to improve productivity and efficiency with a medium cost dependent on the availability of technical information.

In addition to the specific technical changes, there was a recommendation to scrap the old plant and purchase a modern plant. But there was recognition that such a leap is expensive and difficult to implement from local know-how and technology.

The environmental effect of the introduction of the decanter/vacuum filter is improvement in waste handling and reduction of the biological oxygen demand (BOD) while improving efficiency in the raw material usage. The flow meter will reduce water consumption and new pistons will reduce extract losses rated at five litres every 15 minutes, and reduction of lump formation in the spray drying column. Lump generation was reported reduced by 60%. Clearance of 90% of the lump stock in four months was valued at Z$1.5 million. Losses are reported also to have been eliminated in extract saving plants at Z$364 per hour. Restoring manometers have improved pressure monitoring in drying column. Alignment of the column has led to reduction of lump formation. All the above technical improvements have been implemented. Due to lack of information, where implementation is still required is in the reconstitution of the original height cone, which was expected to reduce lump formation and the replacement of old plant equipment by new and modern equipment.

In Zimbabwe the National Cleaner Production Centre has been reported to conduct training for graduates to produce environmental auditors or clean production trainers (Mombemuriwo, 1996). Training institutes were also encouraged to introduce cleaner production concepts in their curricula. Links with the University of Zimbabwe to introduce research students on cleaner production has been explored. The national breweries of Zimbabwe have been audited in addition to the sugar refineries.

4. THE SIGNIFICANCE OF CLEANER PRODUCTION FROM THE FEW CASES IN ZIMBABWE

If we recall the taxonomies from innovation studies (Freeman & Soete, 1997) what has taken place in the clean production audits can be characterised to fall largely in the category of incremental technical innovation. Cleaner production options were identified. Feasibility was tested. Financial and economic assessments were undertaken. And equipment modification to existing plant were suggested and implemented. Certain barriers were noted such as the fact that technical information is unknown to reconstitute an original cone height for reducing coffee lump formation. Most of the technical problems require knowledge for equipment modification and adjustment. When the innovation demands a complete overhaul of old plant equipment it would require overcoming existing conceptual, technical, informational (know-how and knowledge), organisational and economical constraints. The road will be paved to introduce cleaner production systems. But such a radical innovation in turn demands conceptual, policy, institutional and technological synergy and combined action. The cleaner production options would be selected more readily whenever they become enabling to bring about a win-win outcome between environmental benefit and economic profits. In the end building this double incentive to cleaner production policy requires a national strategy to attain at the same time a sort of double dividend between environmental gain and economic gain. Such a macro-national commitment will be a powerful engine for removing the conceptual resistance to the adoption and diffusion of cleaner production options by industries in Zimbabwe as indeed elsewhere in Africa.

5. PROBLEMS OF CLEANER TECHNOLOGY TRANSFER INTO AFRICA

The cases selected show exemplification of the difficulties of incorporating cleaner technologies into African firms. The main problem is that the technology comes from the outside (Muchie, 2000: 22). African countries expect cleaner technology transfer, but actual transfer is not forthcoming. As the Nigerian Government put it: "Available technology in the country appears grossly inadequate to meet with the challenges of implementing Agenda 21 and the programme of transfer of technology is yet to take off fully" (Federal Republic of Nigeria, 1997: 57). What holds for Nigeria may hold for a large number of African countries:

a) available technology is not yet of the cleaner genre and,
b) cleaner technology transfer is yet to take off.

This claim is corroborated with the global trends in R & D levels and FDI flows into Africa. The current trend in Sub Saharan African countries (SSA’s) expenditure of R & D as a proportion of the gross national product (GNP) for the continent as a whole is very low. According to a UNESCO report, the R & D expenditure as a proportion of the gross national product (GNP) for Africa as a whole was a mere 0.28% in 1980, while Asia spent 1.40% of its GNP on R & D, and North America 2.23%. By 1990 the situation had worsened in Africa by R & D dropping to 0.25%, while in Asia it had increased to 2.05% and in North America to 3.16%. By 1990 Africa's share of world R & D expenditure constituted only 0.2% of the whole (UNESCO, 1992).

Have African countries begun to increase their R & D expenditure in general and environmental R & D in particular? The concentration of African countries on science and technology seems to have been lower than on other pressing matters. For example, ‘of the 925 resolutions passed by the OAU Council of Ministers over the 20 year period 1963-82, a mere 3% dealt solidly with scientific and technological issues (and probably 12.5% with associated scientific and technological matters’ (Odhiambo, 1993: 34). Within a single generation, from 1962 to 1988, South Korea's GNP increased from US$2.3 billion to US$169 billion, and this was accompanied by a national investment in R & D which grew from 0.24% of the GNP in 1962 to a massive 2.1% in 1988. Taiwan and Thailand are each following this same pattern (Brown and Sarewitz, 1991).

Human capital construction has suffered in SSA. It has been reported that total public spending on education in SSA fell in real terms between 1980 and 1988 from US$11 billion to US$7 billion. For a sample of 26 countries, this translated into a decline in spending per pupil from US$133 to US$89. In much of Sub-Saharan Africa, educational expansion came to a grinding halt completely by 1989. (World Bank, 1987). Enrolment declined in primary, secondary and tertiary sectors. The decline of the latter was 66% between 1980 and 1985 (World Bank, 1987). This reduction in financing education has lowered the quality of education across the whole spectrum: supervision, inspection, in-service teacher education, curriculum development, and school health services, school furniture, equipment and physical facilities (World Bank, 1987, Barratt-Brown, 1995). In the region of high economic performance 1965 attained - Hong Kong, Korea and Singapore - universal primary education, roughly the same period in which SSA countries were politically decolonising. Investment on education has been high. For example, Korea's real expenditure per pupil rose by 355% over the 1970-89 period (World Bank, 1993: 43).

Enos (1995) has asked the question of whether structural adjustment has facilitated the increase in R & D in SSA. He has undertaken a study of the impact of structural adjustment on science and technology in Sub-Saharan

Africa by studying the national system of innovation of four SSA countries: Ghana, Kenya, Tanzania and Uganda. It is estimated that SSA countries invest roughly 0.5-1% of GDP, and an equivalent percentage on technical education and training (Enos, 1995: 267). Enos suggests that the R & D finance requirement from donors for SSA will be substantial. 'Assistance will be needed for a very, very long time' (Enos, 1995: 270). While Enos was not thinking of environmental R & D, his observation on the need and scale of financial assistance applies equally for generation and transfer of ESTs to SSA.

If we take data on R & D figures from one SSA country – Kenya - the total investment for R & D is about 0.3% of the 1993 GDP of the country. This percentage is below the 0.5% suggested by the International Development Strategy for the Second Development Decade achieved by the end of the 1970s. It is also below the usually suggested 1% of GDP on R & D (Kenya government, 1986). IBRD in its African Development Indicators, 1994-1995 said that Kenya spent about US$11,000,000 in the period 1985/87 on R & D, of which 9.5% is said to have come from the private sector. By 1993, total expenditure on R & D averaged at US$30,000,000 at a GDP level of US$9,388,000,000 (IBRD, 1995: 10). In the period of 1985/87 about 70 private firms were undertaking R & D with a total expenditure of US$951,000 at an average of US$13,800 per firm. In the same period 21 public institutions spent US$10,024,000 at an average of US$455,620 per institution (Nyacet, 1996: 2:). Private sector funding of R & D is lower and supplementary to public funding. Linkages between private and public bodies are weak. Institutional and human capacity need strengthening.

Whereas we have such aggregate figures for R & D expenditure as a percentage of GDP, we do not have a desegregated figure for environmental R & D both as part of gross R & D expenditure or GDP for SSA. Such data will begin to emerge as the environment becomes increasingly integrated in national and regional economic development.

Equally important the current trend in the absorption of foreign direct investment per unit of GDP shows a less than optimistic trend. In 1970 SSA absorbed 5.2 dollars per $1,000 of GDP whilst Asia absorbed $ 2.6 for the same rate of GDP. After 1975 Asia at 3.9 surpassed the African at 3.2 FDI absorption. In 1980 Africa hit a low point of 1 dollar per 1,000 dollars of GDP with Asia at 3.7 dollars per 1,000 dollars of GDP. In 1993 Africa picked up to 9.6 dollars per 1000 dollars of GDP whilst Asia moved to a double digit 23.1 per 1,000 dollars of GDP (UNCTAD, 1995: 80).

From the above figures, it is not permissible to conclude that no FDI and R & D have been transferred to SSA. What is perhaps accurate is that whatever R & D and FDI were transferred could not be of such a large scale as to bring structural transformation in SSA region's national system of production.

In particular there are a set of specific problems related to SSA's structural weakness, which militate against the development of EST-based capacity and innovation system:

a) weakness in technology assessment,
b) doubt over SSA early entry to cleaner technologies,
c) relevance of foreign assistance ,and
d) lack of implementation of Agenda 21

First: the experience of conventional technology transfer has been "very discouraging in most cases in Africa" (UNCTAD, 1995). It remains to be seen whether the UNCED process will make a difference in persuading companies producing pollution controlling technologies to transfer to African firms and economies. One of the necessary conditions is to change the view by established experts to confine Africa’s comparative advantage in the products and processes that utilise ‘simple production technologies’ (Lall, 1989: 94). The African local techno-industrial environment is said to be unresponsive to more advanced technological activities. According to Lall, "there exists a general failure of African private enterprise to enter modern industry in a significant way. Of more advanced technical activity - R & D, design, entry into sophisticated engineering fields - there is practically no sign” (Lall, 1989: 101).

Vernon (1989) suggests that developing countries "that develop a strong internal capacity to search out and evaluate foreign technologies are usually able to acquire the technologies they need on satisfactory terms. Those that fail to search and evaluate, however, can make costly errors”. Technology assessment has emerged as an important discipline whose aim is to evaluate the prospects and risks associated with particular technologies (Clark *et al*, 1991). Technology assessment is one of the areas that African countries have paid the least attention to (Ruijters, 1996). The tendency has been to rely on technological information from those supplying the technology. In many cases, the ability of the African countries to assess technologies is prejudiced by tied aid and linkages between the suppliers of technology and those providing finance (either as grants, equity capital or loans). Human resource and skill construction to build the capacity for technology assessments and to make effective use of technical knowledge in production, investment, innovation and management are necessary. The goal of competency in technology assessment is to transform the acquired technology to support continuous innovation within the domestic setting.

Second: some commentators have raised doubts on the accessibility of early entry to countries with low skills. They question the early entry into cleaner technologies and argue for incremental and radical innovation improvements. For example, Mytelka (1989: 62) questioned the early entry model for lack of appreciation of the skills needed to internalise cleaner technologies as domestic technological capabilities. She argues that those who generally write on leapfrogging have not sufficiently integrated the need for a mastery of skills required for technology absorption with their emphasis on the transfer of productive capacity. Human resource and institutional competence are necessary to incorporate into development policy the public knowledge and information that may exist at the early R & D stage. Willingness to transfer cleaner technologies must be matched by ability to internalise it within a country's national system of innovation. Removal of intellectual property and licensing restrictions can make knowledge available, but that does not ensure uptake by the domestic system unless there is adequate capacity to do so. While early entry possibilities may exist despite new restrictions by new intellectual property regimes, SSA uptake is severely constrained by weak human and organisational competencies.

Bell (1990) seemed to ignore the early entry theory altogether and came nearer the Vernon product cycle when he suggested what he thought possible and practicable: improving on incremental innovations rather than expecting transfer of new and cleaner technologies including the mechanisms and management which might be used to transfer such 'technology'. He advocates 'deepening' the technology transfer content of existing types of 'energy efficiency' by local firms, and 'deepening' the technology transfer content of a much wider range of power sector and industrial investment projects including management training and organisational innovations within the recipient firm. Bell argues for the strengthening of the transnational industrial corporations in order to enhance new forms of alliance and network for technological and managerial learning.

Third: There are also problems between foreign assistance and building national technological capability. Technology transfer can be effective only if it is connected to capability building leading to self-reliance. By the latter is meant the ability of a firm or a country to identify national technological needs and mix local and foreign technology to strengthen the technological accumulation and cumulative capabilities of the country or firm. The real problem is the extent to which the national system of innovation, research, education and skill cohere to promote ESTs to be taken up by local industry. In most African countries, 80-90% of the total recurrent budgets of national R & D institutions is devoted to personnel emoluments. Foreign funding plays a disproportionate role in the organisation and delivery of the research system. For example in Kenya, the ratio of 10:1 describes the research sponsored by foreign sources to the local. In

Ivory Coast and Senegal between 30 and 40 % of scientists are French nationals (Tiffin and Osotimehin, 1992: 44). The link between Government funding and university research is weak, but it is practically non-existent between private firms and research institutes. Local researchers are severely disadvantaged in research agenda setting with respect of international funders. African Governments are known to discourage local consultants showing preference to consultants from the industrialised countries. A directory by IDRC shows that major sources of funding come from OECD based agencies (Tiffin & Osotimehin, 1992). A revealing example of this state of affairs - local research neglect and international research power - is given by the research on 'endod', a soapberry plant.[4] Ethiopian scientists started the initial research. Subsequent research involved international assistance and the result has been patented in the U.S.[5] This was repeated also for another rare millet group crop called "teff", which is also patented in the U.S. and grown in Idaho. During the post-Rio period international co-operation should assist in order to make assistance redundant and not to assist so that more assistance would be necessary. Without such changes local research capacity on ESTs and endogenous technological system building will be unavailable for SSA. The pattern of assistance in the form of project aid often make the foreign consultant to acquire learning and domestic actors often fail to acquire new knowledge to make any difference.

Fourth: In the report of the workshop on the transfer and development of environmentally sound technologies, UNCTAD points out further difficulties in accessing technology: "There were cases where owners of technology had been unwilling to make technology available to licensees, or had set very high prices on it. At the other end of the scale there were also cases where environmentally superior technologies were more or less freely available, but not transferred to developing countries for lack of an attractive market opportunity". The report adds, "such failures were of particular concern where the technologies in question were critical to sustainable development or relevant to global environmental problems". It was also noted that such failures include intermediate technologies and not just leading edge technologies (UNTAD, 1994: 23).

There appears to be failures in the technology transfer market. For a variety of reasons the corporations who hold the patent or control of a given technology

[4] Endod has become an alternative to Bayluscide (niclosamide) manufactured by Bayer Co. and sold at over US$30,000 per tonne. Development assistance has recommended its export to other African countries.

[5] The Ethiopian scientist who undertook the research on endod said: "…the problems of scientific research in Africa include... the reservations of those who find it difficult to accept that good science can come from [Africa]. Even our own Government officials, who rely on foreign assistance and external advice, may be unduly influenced concerning local research" (Lemma quoted in Clark et al, 1991: 34).

may or may not transfer it in spite of the existence of Agenda 21's provisions on technology transfer. Much of the technology transaction takes place among transnational firms, their subsidiaries and associated firms. With or without the provisions on technology transfer from Agenda 21 which their Governments may have ratified even on their behalf the corporations would engage in transfer of technology based on their own assessments of the benefit and loss calculation. Transfer of technology is a matter they can choose to engage in or not. There is thus a need to reconcile the good intentions contained in the UNCED process and the reality of how corporations actually carry out technology transactions.

International funds can assist to transfer ESTs which are not being produced in the developing country regions through such schemes as joint-ventures to enhance domestic capability for ESTs production, and to provide organisational-management, training and skill development. However, technology procurement through foreign assistance comes with its own specific problems (UNCTAD, 1994: 9). For example equipment for environmental protection may not be appropriate to the institutional and human capacity in the recipient countries. There may not be effective demand for ESTs in the recipient countries, which may discourage technology procurement. There may also be a mismatch between the needs of the domestic economy and the ESTs from external sources. And there is often weakness in co-ordinating policies for technology procurement and national or regional industrial policies.

These problems tend to go worse in countries where the technological capacity, skills and organisational structure are low. In order to make endogenous a dynamic EST industrial sector, foreign assistance can be used to assist in smoothening the technology from the outside to overcome the domestic barriers to enable its effective utilisation and diffusion. Foreign assistance has to be guided by policy priorities for technology co-operation to stimulate local knowledge by building on the available knowledge and experience of the domestic economy of the recipient countries (UNCTAD, 1994). Technological transfer through co-operation is effective only if it leads to the internalisation of technological capabilities, accumulation and institutional competence and learning inside the domestic social-economy.

Both the prime sources of technology capability and technology transfer, R & D and FDI are low in the aggregate, although the figures may vary in specific African economies. This suggests the scepticism by Nigeria that technology transfer is something that is expected to take place in Africa yet.

The main constraints faced by the SSA region in preventing an uptake of ESTs are related to lack of awareness of the economic benefits of cleaner technologies, lack of knowledge and information about cleaner techniques and technologies and lack of financial resources to purchase imported ESTs. These problems can be overcome provided concerted action by international organisations, national governments, industries is taken. UNIDO and UNEP have jointly created the national clean production centres. These centres have been engaged in local capacity building, information dissemination, training and education, inter-sectoral demonstration projects, creating co-operative arrangements between environment service sectors between developing and developed countries and research on environmentally compatible products (UNIDO, 1995). However many of these centres in Africa remain fuzzy, not connected to the system of knowledge generation, production and public policy management (Muchie, 2000: 22).

CONCLUSION: THE UPTAKE OF ESTS IN FIRMS AND INDUSTRIAL POLICY

Agenda 21 has stimulated the adoption of ESTs in African firms. From the reports of the cases of cleaner production assessment undertaken by international consultants, there is incontrovertible evidence that a number of African countries have begun to take cleaner production concepts on board. At the same time the few examples of cleaner production assessments indicate that the selection of the firms is ad hoc and is not governed by any comprehensive national strategy integrating environmental constraints into African industrialisation and poverty reduction game plans. National legislation on environment incorporating the UNCED principles is increasingly being adopted. Investigations of environmental management practices and environmental audits have been undertaken in a number of sectors and firms.

The NCPC concept is novel. And while the idea is to be encouraged, it must be conceptualised within the poverty reduction and industrialisation programmes of African states. It needs to be articulated as part of a national industrial policy. The NCPCs can be one of the vehicles for the expression of the eco-industrialisation model of development suggesting a conceptually, institutionally, strategically and policy-level integration of African industrial evolution and environmental security.

Whilst there is evidence of ESTs activity, a thorough research is needed to establish the rate of diffusion of cleaner production activities within firms, either by taking firms from more African countries and/ or more firms within a few African countries. The best way forward for African economies is to learn quickly to reveal new comparative advantages on the basis of sustainable development. This translates in the African context as the creation of new industries by drawing from the natural resource base of the countries. There is thus a need to undertake more empirical studies on the creation of value-added manufacture of the agrarian sector through ecotechnology capability and competence building and learning.

The integration of environmental technologies and industrialisation through research, development and capability building may build a new avenue to reveal Africa's comparative advantage in high value-added production in order to unhinge Africa's position in the current frozen international division of labour as exporters of extractive minerals and primary commodities. As I wrote elsewhere: "The main policy problem is internal rather than external. It should address the problem of how the SSA region can and should re-organise in order to build knowledge, skills, learning, capabilities, institutions, incentives and resources to address economic and environmental problems."(Muchie, 32,2000). Africa can ditch the 19th-20th centuries industrial system, if it can create the conditions for ecological industrialisation in the 21st century on a Pan-African scale and scope. Public policy in Africa can focus in marrying environmental technologies to African rich natural resources and make Africa's time for building its future with trade and investment in high value added cleaner products and services.

References

Barratt-Brown, M. (1995) *Africa's Choices*, Penguin, London

Bell, M. (1994) M, Report *for the Resource Group in Norway* in Svarstad, Norway

Brown & Sarewitz, (1991), *Fiscal Alchemy*: *Transferring debt into Research,* Issues in Science & Technology,

Clark, N. and Juma, C. (1991) *Biotechnology for Sustainable Development: Policy Options for Developing Countries*. Nairobi: Acts Press.

Enos, J.L. (1995) *In Pursuit of Science and Technology in Sub-Saharan Africa: The Impact of Structural Adjustment Programmes*. London: Routledge/UNU Press.

Federal Republic of Nigeria (1997) *Towards Sustainable Development in Nigeria*, National Communication on the Implementation of Agenda 21 for the Special Session of the United Nations General Assembly, June 23-28, New York.

Freeman, C., and Soete, L., (1997) *The Economics of Innovation*, Pinter, New York & London

IBRD (1995) *African Development Indicators 1994-1995. Oxford/New York, Oxford University press*

IBRD, (1987) *Education Policies in Sub-Saharan Africa*, Washington, D.C., WorldBank Publications

Kenya Government (1986) *Sessional Paper no.1 of 1986 on Economic Management for renewed Growth,* Nairobi: Government Publisher.

Lall, S. (1989) achieving a More Ideal Structure. In: Meier, G.M. and W.F. Steel (eds.), *Industrial Adjustment in sub-Saharan Africa*. New York: Oxford University Press.

Migiro, C.L.C. (1996), *and Cleaner Production Regional Perspectives: Africa Region,* Paper to the Fourth High Level seminar on Cleaner Production, 23-26, September 1996, St. Catherine's College, and Oxford.

Mombemuriwo, L. (1996) *The Cleaner Production Centre of Zimbabwe Newsletter*, Issue no.1, July.

Muchie, M. (2000), *and Barriers to the uptake of cleaner technologies in African countries*: the Case of Tanzania, in **Science, Technology & Society**, Vol.5, no.1

Muchie, M. (2000), *Old wine in new bottles critical exploration of the UN's conceptions and mechanisms for the transfer of environmentally sound technologies to industry*, in Technology in Society, Vol.22

Muchie, M. (2000), *Searching for opportunities for Sub-Saharan Africa's renewal in the era of globalisation***, Futures**, *32*

Mytelka, L. (1989) *Ivorian Industry at the Crossroads*. Paper presented at a Workshop on Alternative development Strategies in Africa, Queen Elizabeth House, 11-13 December, University of Oxford.

Nyacet, N.N. (1996), *Mobilisation of Financial Resources for Research, Science and Technology in Kenya, unpublished manuscript.*

Odhiambo, T. (1993) UNESCO, *World Science Report*, Paris, UNESCO Publications.

Ruijters, Y (1996) *The Relevance of Environmental Legislation for the Transfer of Environmentally Sound Technology: The Tanzanian Experience*, Discussion Paper, January, Maastricht: UNU/INTECH.

Tiffin, S. and F. Osotimehin (1992) *New Technologies and Enterprise Development in Africa.* Paris: OECD.

UNCTAD (1995), Foreign Direct Investment in Africa, New York & Geneva: UNCTAD.

UNCTAD and the Government of Norway (1994), *report on the Workshop on the transfer and development of environmentally sound technologies.* New York & Geneva: UNCTAD.

UNEP (1996) *Industry and Environment*, Vol.19, No.3, July-September.

UNESCO (1992), *Statistical YearBook.* New York: United Nations.

UNIDO (1995), Memo, progress report for meeting in Berlin 5-7 October 1995, Vienna, UNIDO Production'

Vernon, R. (1989), *and Technological Development: The Historical Experience*. Economic Development Institute Seminar Paper No. 39. Washington DC: World Bank.

World Bank (1993) Report on Sustainable Development, Washington D. C., 1994.

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