Assessment of Technology Transfer in Seychelles within the context of Climate Change

Edited by Rolph Payet

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1. Assessment of Technology Transfer in Agriculture

Author: Antoine Moustache

Identify the Key Issues of Stakeholders Within that Sector Concerning the State of the Technology use Within the Sector.

The ***Seychelles' Initial National Communication*** under the United Nations Framework Convention on Climate Change (October 2000) reported on various sources of GHGs within the agricultural sector of Seychelles. It is noted that in the year 1995, 75.5 tonnes of N_20 and about 205 tonnes of CH_4 were emitted. The CH_4 emission originated only from enteric fermentation in domestic livestock (pig & cattle) while the N_20 emission originated from the soil application of commercial nitrogenous fertilizers along with soil organic matter in the form of manure and slurry.

In livestock rearing environmental concerns (smell, ground water and stream pollution) dictate the manner in which manure from cattle, chicken and pig production particularly are disposed of. Cattle in the Seychelles are principally kept as manure factory, with milk and meat as bi-products. The farmer harvests the dung and urine output and stretches its organic matter content through the addition of dried grass and dried leaf bedding. The mass of dung, urine and bedding mixture is regularly removed (weekly) from the cattle pen and stored in low heaps in a sheltered area, with regular turning of the manure heaps in many cases. This definitely promotes its aerobic decomposing with little or no production and emission of CH_4.

In the same manner both broiler and layer chickens are reared in systems (deep litter or battery cages) that allow adequate aerobic decomposition of their droppings. Furthermore, the mixture of droppings and dry litter are allowed to decompose in sheltered low heaps for at least 3 months before being applied to cultivated soils.
In both steps there is little or no CH_4 production and emission.

In the case of pig production the use of relatively large volume of water to wash the sties on a daily basis produces a considerable large volume of slurry. Environmental concerns require that the slurry is collected in large shallow concrete ponds or reservoirs to ensure adequate aerobic decomposition. Regular evacuation (weekly or so) of the slurry reservoir is carried out with the relatively well decomposed slurry, which has a fertilizer value, sprayed onto agricultural tree crops such as banana, plantain and pawpaw as well as pumpkin and forage such as elephant grass. It is believed that during the period that the slurry is held in the reservoir insignificant amount of CH_4 is produced.

Within the coming 10 years (up to 2010) the National Agricultural and Fisheries Policy 2000-2010, which has as overall objective the enhancement of national food security, calls for 100% local pork, poultry meat and egg production. Additionally, it calls for at least 80% local production of fruit and vegetables consumed locally, noting that beef production would not be changed from its current status. In arable crop production the policy calls for the cultivation of arable crops on an additional

250 hectares of land to attain the set targets. These would require organic matter, manure and inorganic fertilizer inputs in view of the inherent infertility of the Seychelles' soils. In the same manner, additional broiler meat and layer poultry stocks along with pigs would have to be reared. Consequently, the rearing of an even larger population of livestock and the cultivation of a larger area of land, in comparison to the present, would potentially increase the possibilities for CH_4 and N_20 production and emission.

The currently adopted cultural practices for the application of soil inorganic fertilizer, manure and other organic matter, stipulate that these are incorporated into the soil for maximum efficiency. This method ensures also that there is minimum loss of volatile components such as ammonia (NH_3) from nitrogenous sources. In the same manner, the present practice for manure and slurry disposal, prior to soil application, is universally used. Indeed, it is unlikely that the process of enteric fermentation, the fundamental source of CH_4 production in livestock, can be manipulated without undesired results on the performance of the animals.

Consequently, the cultural practices adopted locally, both in livestock rearing and arable crops cultivation, coincide with those practiced internationally for minimising CH_4 and N_20 production and emission.

Within the same context, the use of slat floor in pig sties for solid waste disposal would reduce the amount of water used daily for cleaning. This would considerably reduce the volume of slurry for eventual disposal into the environment, avoid large accumulations in slurry reservoirs and hence avoid any possible anaerobic decomposition.

The Local Markets and the Technology Needs that are Critical to the Agricultural Sector over the Next 3 to 10 Years

The local farmers (food producing entrepreneurs) would form the bulk of the local market in the given time frame. Indeed, to meet the targets set in arable crop and livestock production there would be between 800 and 1000 production farms (currently at 520) of about 0.5 hectare in the Seychelles by the year 2010. This would engage a total of about 400-450 hectares of land under farming. It would follow then that if a higher food security is to be attained a larger livestock population has to be kept and a larger land area has to be cultivated. Although this would have the potential to increase the production of CH_4 and N_20 through respectively enteric fermentation and larger application of soil organic matter and inorganic fertilizer, there is no foreseeable cost effective technology to mitigate this outcome.

Critical Low GHG Emitting Technologies Required to Meet These Needs and Demands of Future Markets

The use of slat floor in pig's sties would considerably reduce slurry volume output. This would potentially however have a greater bearing on lowering environmental

pollution risks rather than mitigating any possibly increase in CH_4 production and emission. This is so because the current technology of pig slurry disposal does not encourage CH_4 production.

Evaluate the Findings with Existing Technologies

As stated above the use of slat floors in pig sties would considerable reduce slurry volume output and hence the volume to be disposed of eventually. It would also have positive impacts on reducing the level of smell, ground water and surface stream pollution, limit the potential size of the area for the breeding of mosquito and house fly and the proliferation of vermin's and rodents like the rat. It would surely further reduce the volume of water applied daily for cleaning. It would thus provide potential for more effective use of water and labour. Above all pig production through the use of this technology will be possible in zones that are now constrained by water shortages, smell pollution etc. Thus by engaging these technology new areas/zones for pig production could be opened up with potentially lower environmental consequences.

Gaps and Weaknesses in Areas of Market Drivers (cost competitiveness as between importation and local availability, environmental issues, customer preferences) Technology Drivers (capacity, barriers to transfer) and Legal Drivers (policy, standards, regulations, trade).

- **Market drivers**: The technology calls for slat floors in pig sties. By virtue of the fact that through established behaviour pigs always defecate and urinate in a selected area of the sty, it would require that only a relatively modest area of the pig sty floor is slatted. Additionally, while commercial slat boards are available overseas, this concept can easily be reproduced locally through concrete slabs with slats of the appropriate size with no forbidding cost implications. The use of slat floors can only have good environmental repercussions and customer preferences would not be a critical factor. Nonetheless, to be effective and efficient, the slats have to be of the required dimension and must properly be positioned. Furthermore, an effective system must be in place to remove the solid waste from under the slat floors for eventual disposal.

Policy Dimension	Applicable Policies Currently in Place	Effectiveness of These Policies	Gaps in These Policies
National systems of innovation	Educational policy, International trade policy, Vocational training policy, Industrial policy, Agricultural policy	None of these policies are effective in technological development and innovations vis-à-vis the mitigation of fossil energy reliance except for the National Energy Policy	Educational policies place emphasis on academic train while vocational policies emphasis the acquisition of ba skills. International/regional trade policies are at an ea development stage while the Industrial policy does not fo on innovation and technology transfer. The Agricultural Policy although emphasizes technol transfer and innovation, it does not focus on those relate

			the mitigation of fossil energy reliance in the sector.
Social infrastructure and participatory approaches	None	N/A	N/A
Human & Institutional capacities	There is no national human & institutional capacity development policy. However, each ministry may have its own human and institutional capacity development policy as reflected for example in the Agricultural Policy 2000-2010.	The Agricultural Policy 2000-2010 is yet to come on stream. While the Policy Framework specified its mandate, the opportunities through bilateral and multilateral cooperation do not necessarily coincide with the aspirations of for example the Agricultural Policy 2000-2010.	The Agricultural Policy 2000-2010 does not entertain issue of the need to mitigate fossil fuel energy use in agricultural sector. Consequently, it does not propose human capacity development in this regard.
Macroeconomic Policy Frameworks	The current Agricultural and the macro-economic policies do offer some direct and indirect financial support to the sector. Additionally, trade and foreign investment are facilitated under the Business Act.	These policies are effective in purchasing inputs at low leve3l of mark-up in facilitation with investment funds and starter capital or in securing tax concessions for export oriented agricultural activities	These policies do not necessarily entertain the subject mitigating fossil fuel energy reliance on the agricultu sector
Policy Dimension	**Applicable Policies Currently in Place**	**Effectiveness of These Policies**	**Gaps in These Policies**
Sustainable Markets	The National Energy Policy	The national policy framework defines sustainable market approaches for renewable energy and energy efficiency technology transfer along with the intended market transformation programmes that focus on technology supply and demand	While there is such a national policy framework in pl there is no consideration given to the national agricultu sector specifically.
National legal institutions	The legislation in place covers issues of Patent, Copyright, trade and service marks. However they are out acted	The legislation are well over 100 years old	The legislation do not entertain present issues of Pat Copyright, trade and service marks
Codes, Standards & certifications	The Seychelles Bureau of Standards (SBS) various policies on codes, standards and certification	These policies do guide new local products in meeting the set standards, conform to codes and thus get the required certification	While there might not be any major inherent gaps in policies there needs nonetheless to be more publicity so a encourage the use of standards codes/certification
Equity Considerations	The current social policies have inbuilt equity considerations	The equity considerations are in connection with social issues only	The equity considerations do not relate to technol transfer
Rights to Productive Resources	There are no national policies or legislation pertaining to rights to productive resources	N/A	N/A
Research & Development Technology	Education Policy (Vocational training Policy), Industrial Policy, Agricultural Policy	Education Policy places emphasis on academic training, while the Vocational training policy emphasizes the acquisition of basic skills. Industrial Policy focuses on industrial development	None of the policies focus on science infrastructure, pul research laboratories or facilitate through research grants invest in research and development except for Agricultu Policy which sees to research and technology developm in the agricultural sector

Case Study 1: Promotion and Adoption of Tropical Green House Technology by Seychelles' Farmers.

Keywords: (Tropical) Green house technology, promotion

Summary: Traditionally, the rainy season spanning the period from November – April, is not conducive for field cultivation of vegetables leading to a scarcity of locally grown vegetables. It was believed that the application of a suitable green house technology could facilitate vegetable cultivation year round by Seychellois farmers.

Over a period of 3 years i.e. from 1993-1966 a number of different green house prototypes were evaluated on the research farm by consultants of the Food & Agriculture Organisation (FAO) of the United Nations and technicians of the Ministry of Agriculture and Marine Resources (MAMR) Seychelles. A suitable version was identified with greater efficiency to ventilate with prototypes in either wood or galvanized steel pipes. The most efficient prototype was further evaluated on farmers' fields with comparisons in productivity between the prototypes and open-field cultivations during the two major seasons. Vegetable productivity under open-field conditions during the rainy months was almost nil in comparison with productivity under the green house which was in excess of 80% of the productivity of the cool dry months of May to September.

Approach: The need to define an infrastructure that would lessen or even eliminate altogether the impact and damaging effects of the rains of the rainy months and consequently extend the possibility of growing throughout the year was the fundamental rational for undergoing such as exercise.

By extending the growing season in Seychelles there would consequently be a greater local potential to produce more food which would have had a direct positive influence on the national food security. In this regard thus the Seychelles' Government through the Ministry of Agriculture & Marine Resources (MAMR) sought external assistance through the submission of a technical cooperation project proposal to FAO. Once the project proposal was accepted, a three year field evaluation of various prototypes of green houses was conducted by FAO consultants and field technician of MAMR. The final phase of the field investigation i.e. the last 12 months involved a number of innovative farmers which facilitated with the process on their fields. While there was no set timetable for the field evaluation the duration of the process was constrained only by the definitive length of the technical

cooperation project, the two phases of which could not be in excess of 36 months.

Impacts: The successful outcome of the evaluation process with the definition of a green house structure that could extend the growing season over the entire year had indeed tremendous national impact vis-à-vis the status of national food security. Additionally, the mere fact that the growing season was extended by another 6 months with about 80% of the productivity of the cool dry season meant that in theory a similar figure of economic activities could be generated. However, taking into consideration that crops grown during the rain months traditionally fetch a higher prices (as the period also coincides with important national festivities e.g. Christmas, New Year) meant that the potential to generate higher farm revenue during that period was greater.

A core group of technicians was trained in all aspects of the construction of the various green house prototypes. They further trained all farmers interested in adopting the technology. Besides, a large section of MAMR front line agents were exposed to the technology and inevitably became the agents of change in the midst of farmers, providing the relevant information on the said technology. Promotion is still being conducted on tv, radio, newspaper, in fairs and open day. The greatest indicator of the positive impact of the technology is the significant and remarkable availability of a large range of common vegetables throughout the rainy season. The technology has been adopted by 10% of the farming community. While the cost factor is not a limiting factor, the unavailability of the require inputs has had the greatest impact on the rate and range of adoption.

Lessons Learned:

- Adoption of a technology is partly a function of satisfying a need of an important group (in terms of numbers) of the community/society;
- Adoption of a technology is related to it solving a significant problem;
- Adoption of a technology has to bring (important) economic benefits over and above one in current use;
- Adoption of a technology is also a function of its cost of acquisition. If it is too expensive its adoption will only be by a few;
- Adoption of a technology is related to the availability of the required inputs (parts) of the technology and the availability of a service.

Case Study 2: Promotion and Adoption of Low Volume Water Applicators and Fertigation Techniques by Seychellois Farmers

Keywords: Low volume water applicators, mini sprinklers, misters, drippers, fertigation.

Summary: With the ever growing shortage of irrigation water on farms there was a need in 1993 to investigate the suitability of a number of different types of low volume water applicators on farms where traditionally a contribution of overhead sprinklers, watering can and open end hose irrigation had been common. Additionally, it was found desirable to explore the possibility of applying fertilizer in the irrigation water, a process known as fertigation with a view to optimize the use of fertilizer. The initial field work was done one the research farm on common vegetables (both leafy and bulb) irrigated through drippers and mini-sprinklers with various output capacities. To

address the irrigation requirements of the crops cultivated, the total amount of water applied was correlated to the loss through evaporated as reflected in the pan evaporation. The largest portion of the daily water requirement was applied at the time the plants needed most i.e. between 10.00 a.m. and 4.00 p.m..

In the same manner each crop under fertigation had its own nutrient requirement defined and the fertilizers (nutrients) were diluted according that the mini-sprinklers or drippers applied the correct amount while irrigating. In another phase of the evaluation few innovative farmers were selected to host the experiments on their farmers.

Indeed, this technology package was utilized in conjunction with the tropical green house technology just as much as it was useful under open-field conditions. Its primary objective was to introduce water use efficiency in crops cultivation and with the fertigation technique also include the element of efficiency in fertilizer use. Secondary benefits accrued included better crop performance and consequently higher crop productivity.

Approach: The primary rational in the use of these low volume water applicators was water use efficiency which along with fertigation also involved fertilizer use efficiency. The first rational situates itself in the context of the ever decreasing availability of the water resource particularly during the dry periods which have been much more pronounced in the last five year. Similarly, fertigation offered the possibility of optimizing fertilizer use by applying it in small doses in a regular basis and where it is most needed i.e. in the root zone. This would lead to a relative reduction of national fertilizer consumption and consequently save on foreign exchange as it is all imported. Besides, there are environmental benefits through a reduction of fertilizer use.

Government played an important role in an incessant campaign of promotion of this technology package which have a direct bearing on the national food security through increased crop output.

Impacts: The implicit basis for popularizing the use of low volume water applicators is that there is no need as long as there is sufficient pressure (around 1.5 bars) in the system through gradient difference there is no need for motorized equipment such as pumps. Out of the 46 farmsteads that utilize the technology presently only a handful required motorized equipment. Some indeed opt to include it in the system so as to operate a larger portion of the system at any one time. So there is an effective reduction in energy use on many large farms which previously utilized motorized pumps to power overhead sprinklers over large irrigation surfaces.

A number of technicians form the core groups which promotes the technology among farmers and regular introduce it to other target groups. Beside, the technicians contribution to regular media publicity of this technology for general education and awareness programmes.

The increased crop output especially in the dry season from farms with this technology package is an important indicator of the positive impact of this technology. Furthermore, labour usually employed for irrigation is freed to undertake other productive activities and consequently contribute in improving farm output.

Lessons Learned:

- Adoption of the technology relates to solving an issue (water shortage) which affects a wide community;
- Adoption of the technology brings on added benefits such as free hands that were previous freed up for irrigation activities; increase farm productivity through higher crop output, etc;
- Adoption of a technology enhanced through continuous sensitization awareness/education programmes of its benefits and the issue that it solves;
- Adoption of the technology relates to its availability and affordability. It has been determined that the poor rate of propagation of the technology locally is not linked to its cost but rather to the low availability of the parts.

Case Study 3: The Promotion and Adoption of Integrated Pest Management (IPM) Techniques by Seychellois Farmers

Keywords: Integrated Pest Management, IPM

Summary: Pest control techniques now entail a pest management approach which is diverse and varied in order that the pest under consideration is effectively managed, it does not develop resistance to specific pesticide and there are fewer ill consequences to the environment.

The use of a combination of diverse and varied methods to manage one particular pest is termed integrated pest management (IPM) and this approach was tried out at different times in Seychelles over the last twenty years. However, to-date its adoption has been insignificant among Seychellois farmers. The approach employ a series of management measures to manage one particular pest and its sustainability and thus its success in achieving continuous pest management lies in the fact that the measures have to be adhered to for example in the management of the cabbage worm an important pest of cabbage in Seychelles, the measures that can be applied concurrently are: a pesticide to kill off the worm when the population is high, the use of a few light traps (kerosene lamps placed in the cabbage plot at night), growing plants e.g Marigold that are repulsive to the moths that lay the eggs, irrigating late evening so as to deter the moth from laying as it is most active at that period etc; use of spray containing mixtures of garlic, onion and chilli in solution etc. While the IPM approach has been sufficiently researched in a number of tropical countries e.g. India, Taïwan etc, this has not been the case in Seychelles. Consequently, its promulgation and adoption by the farming community has not been successful.

Approach: The IPM approach removes the total and almost over reliance on pesticides for pest management. By introducing a series of management measures that could be applied concurrently it was believed that a particular pest would not develop resistance to one or few pesticides, that are used continuously and thus became ineffective in its management. Additionally, the concurrent use of other measures which were not pesticidal in nature would have led to positive impact on the human health and the environment and possibly incur lower to the farmer.

Few significant studies were done in the field to evaluate the Prescribed Practices that were successful elsewhere. In a number of cases those studies disjointed and did not have suitable personnel for supervising the filed activities. In another dimension the IPM approaches were introduced to large groups of farmers in workshops at various periods. However, they remained 'hearsay' and lacked the clout of field findings/outcome under local conditions. Thus although the ideas about the possible outcome were good they lacked local practical field experience and thus were not convincing.

Impacts: Indeed to date the introduction of such a technology package has failed as there are no recognizable adoption under local field condition.

Lessons Learned:

- There were no discernable and comprehensive field evaluation of the technology package;
- There was inadequate personnel input in the evaluation process;
- The evaluation process was haphazard generating incomplete information;
- The farmer involvement (stakeholder) was non-existent and thus did not find a sense of belonging;
- The various measures used in IPM were not demonstrated to the farmers and results were not seen. Thus there was a lack of conviction.

Actions Required to Implement the Critical Technologies Identified

These will be as follows:

- Design of types of concrete slabs with slats for use in pig sties;
- Redesign pig sties to accommodate slatted floors;
- Testing of the combined structures;
- Evaluation of the combined structures;
- Formulate into a few standard designs with various capacities and subsequently made available for a fee for use by pig farmers;
- Monitor performance of those structures overtime for possible modification;
- Promote widely through awareness programmes through mass media, demonstration, open day, personal contact etc…

Table: A Matrix Showing Key Socio-economic, Legal and Capacity Needs against the Technology Transfer options to attempt to Determine the Best Potential for Technology Transfer.

NEEDS			
Technology transfer options (slat floor technology and pig sty design)	Socio-economic • Make available a few standard designs of pig sties with slat floors for various pig carrying capacities at a nominal fee; • Cost of construction using such design should either be similar or even lower to current design.	Legal Revise Environment Act and other legally binding regulations to promote pig rearing using the said design in presently off-limits and environmentally sensitive areas.	Capacity • Educate and raise awareness among potential users to promote its use; • Promote it as a mandatory design in the Pig Production Promotion Committee; • Have a core group of extension agents to technically support the producers during the pig- sty construction phase.

The Key Partnerships and Enabling Environment that Need to be in place to Facilitate Transfer of those Favourable Technologies.

The primary key partners would be the Ministry of Agriculture and Marine Resources and the pig producers. However, the Ministries of Health, Environment and Land Use and Habitat, through the Pig Production Promotion Committee that vets application for pig rearing by potential and existing pig farmers, have a bearing on the promotion and success of this technology.

The Ministry of Agriculture and Marine Resources through its Agriculture Development Fund makes available loans at 8% interest to potential producers of sums of up to a maximum of SR 100,000 with grace periods of up to 12 months. Furthermore, through the Livestock and Veterinary Sections of the said ministry, technical support is afforded to current and potential producers either for free or at a nominal fee. If the extension agents can focus on the promotion of the technology once evaluated it would contribute to its successful transfer.

Criteria for Effective Technology Transfer

GHG reduction potential: By effectively reducing the volume of slurry output in pig production enterprises, through the use of slat floor and lower amounts of water for cleaning the pig- sties, even in the face of much larger pig population, there would be important reduction in CH4 production through anaerobic decomposition of slurry.

Other environmental consideration: Lower volumes of slurry would effectively reduce the potential for smell, ground water and stream pollution. It would reduce the effective area acting as breeding sites for the mosquito and the house- fly, food source for rodents like the rat and eventually reduce the volume of slurry to be disposed of into the environment.

1. *Economic and Social Criteria*

Cost effectiveness: It is not expected that the slat floor design would be more expensive than the currently adopted solid floor design. Indeed, it is expected that the slat floor and associated structures would be less costly than the currently used design which calls for investments in large concrete slurry ponds, large water reservoir, pressure hoses etc. There would be more cost effective use of labour and water as there would not be a necessity to clean the sties every day.

Adequate financing: Various locally available financing schemes could be tapped and these include the Ministry of Agriculture and Marine Resources' Agricultural Development Fund which offers loans of up to SR 100,000 at 8% interest rate with grace periods of up to 12 months. Indeed, the adoption of the technology calls only for a modest change of design and if there are extra costs to be incurred in comparison with the current design, then these will be offset subsequently both in terms of more effective labour utilization and fewer requisite infrastructure and resources.

3. *Administrative, Institutional and Political Criteria*

Information about the technology: Pig producers can be made aware of the technology through the mass media (tv, radio, newspaper), through personal contact with the extension agents of the Livestock Section of the Ministry of Agriculture & Marine Resources, through field days and demonstration at a site where the technology is being applied, through mandatory inclusion in structure design or through the purchase of pig sties designs which incorporate the technology which are eventually vetted by the Pig Production Promotion Committee.

Access to the technology: The technology can be bought and acquired from overseas or locally. The local design would be a standard one incorporated into concrete slabs which can interlock with each other. A standard mould to prepare and cast the concrete slabs with slats can be made available by Government or the private sector. Its acquisition does not necessarily involve foreign exchange outlay.

Administrative burden: Once the necessary preliminary field investigation has been carried out and the technology has been popularised, it would be the duty of the existing Pig Production Promotion Committee to see to its promulgation by vetting all applications for pig rearing and production and to see that the technology is incorporated in all pig- sty designs.

Political considerations: The promulgation of this technology would not have any recourse for any political considerations while its promotion and adoption can only lead to positive environmental repercursions.

Replicability: The simplicity of the technology would give it great adaptability to different geographical and socio-economic and cultural settings.

4. Process – related Criteria

Market penetration: Its simplicity and passive nature would bestow it with the potential to be rapidly indigenised, have wide geographic penetration and to be compatible and synergistic with other technologies eg biogas and renewable energy production using livestock slurry.

Long-term institutional capacity building: By virtue of the simple and passive nature of the technology it does not require any long- term training for its adoption. Indeed, after its short-term evaluation, it can be adapted to changing circumstances and its own improvement can lead to better management practices.

Monitoring and evaluation of continuous delivery of services provided by the technology and adequate financial performance: Once adopted the technology becomes an integral and passive part of the pig sty structures and needs to be maintained in the same manner that other structures are maintained. It is a one off investment with a definite life span and its replacement does not involve any significant capital outlay in comparison to the overall cost of the infrastructure where it is being utilized.

A Stakeholder Typology

- **Sources and developers of the technology**:
  The technology can be developed, tested and evaluated by the Livestock Section of the Ministry of Agriculture and Marine Resources either on a government farm or on a

private sector farm. It could be done in collaboration with the Ministries of Environment, Health and Land Use and Habitat.

- **Owners and suppliers of technology**:
  The technology, once evaluated, can be spun- off to the private sector to ensure its market availability and to exploit its market potential. However, by virtue of its simplicity and low cost, government can always make it available for a nominal fee to every single consumer.

- **Financiers of technology transfer**:
  As the technology is simple and low cost its transfer should be facilitated by locally available small loan or financing package.

- **Information providers**:
  Government should remain the primary information provider in the effort to promulgate this technology. The private sector could become a secondary information provider in few areas of the technology application

- **Market intermediaries**:

  Livestock Section extension staff and the media should act as market intermediaries. It is perceived that the promulgation of this technology would not lead to any important profits or financial gains by any single individual or group.

- **Government**:

  The Seychelles' Government would probably promote this technology as it perceives the technology to have immediately greater environment externalities (reduction of smell, ground water, surface stream pollution etc), rather than its inherent ability to reduce GHG production and emission. However, its application would nonetheless have repercussions in reducing potential GHG production.

2. Assessment of Technology Transfer in Fisheries

Author: Rondolph Payet

Introduction

To achieve sustainable development, sustainable technologies need to be developed, transferred and adopted. It has been argued that in developing economies the critical issue is not so much advancing the frontier of technical knowledge but rather taking advantage of opportunities to exploit the technical advances already generated by economies in the developed world. Ability to mitigate climate change depends largely on technological innovation and diffusion of technologies.

IPPC (2001) argues that adaptation measures are likely to be implemented only if they are consistent with or integrated with decisions or programmes that address non-climatic stress. Therefore, the approach taken in this study for climate change adaptation will consider non-climatic stresses and consistent with existing fisheries policy criteria, fisheries development objectives, and fisheries management structures. It is important to note at the outset of this report that there are no preset answers to enhancing technology transfer and usually the actions are tailored to address specific barriers faced when transferring technology in fisheries. Moreover, the fishing industry of Seychelles is very complex in nature, using a variety of technology and depends heavily on fossil fuels to charter the fishing grounds.

Anon (2000), notes that whilst there are many difficulties associated with the adaptation options proposed for the fisheries sector, the consideration of the scale provides some guidance to the essential features of an effective strategy. The climate impact on fisheries and its ecosystem is based mainly on the extent to which the environmental variability will influence the fish stock, its socio-economic impacts and changes in the habitats structure (e.g. coral bleaching, fish distribution, fleet dynamics).

This report provides an overview and assessment of national policies and actions leading to possible mitigation, illustrated through a series of case studies; critically accessing the technology options proposed in the Seychelles Initial National Communications and elaborating on the criterion for effective technology transfer and adoption in fisheries. The focus will be on the domestic sector of the industry where most of the experiences are drawn. The industrial fishery is dominated exclusively by distant water fishing nations will only be mentioned, as Seychelles has no direct influence on the technology being used or transferred unless it is of environmental and fisheries management concerns. In 1999, however Seychelles registered a number of longliners and purse seiners which gave rise to another dimension of technology transfer which this report does not address .

Technology Transfer in Fisheries

Overview of the Fishery

Fisheries have traditionally occupied an important place in the life of the Seychelloise and the sector makes an enormous contribution towards food security and socio-economic

development of the country. In 2000, the fisheries sector accounted 696 million of foreign exchange net inflows, making it the primary foreign exchange earner.

The domestic fishery of Seychelles is diverse ranging from part time to capital-intensive operations. The artisanal fishery is based mainly on the exploitation of demersal species and the semi industrial fishery targets tuna and billfishes. The semi-industrial fishery is a relatively new fishery with 11 vessels and landing around 350 tonnes per year. There is also an industrial fishery, which is exclusively prosecuted by distant water fishing nations under bilateral access agreements as well as on a private basis. The industrial fishery is dominated by developed countries with a high level of technology. Whilst technology transfer in this sector may not be of direct interest to the Seychelles Government, the worrying issue is the efficiency of the technology vis-à-vis the exploitation of the tuna stocks. It has been observed that fishing efficiency of purse seiners have increased by at least eight fold since the beginning of the fishery in 1983, especially in fish detection (sonar and bird radar). Fishing technologies in the domestic fishery sector are described in table 1.

Table 1: A summary of fishing technologies in use in the domestic fishery

Vessel Type	No of vessels	Description of boat	Gear	Description of method/activity	Species	Fishing Location
On foot Fisher-men	5-20 (fisher-men)	Fishing without a boat on the reef flat and shallow lagoons.	Harpoon and fish trap, small seine	Harpooning is used to catch octopus by retrieving it from its den. Small seine nets are used from the beach to target sardines for bait.	Octopus, reef species (siganides, lethrinides, sea cucumber lutjanids), lobster sardines, mullets	Shallow reef areas, grass beds, depth 3-10 metres
Pirogues	16	Traditional wooden fishing boat used with paddles or like a punt, recently equipped with a 15 hp or higher outboard engine. Manned by 1to 2 persons.	Hand line fish trap and Beach Seine (only one unit in the fishery).	The fish trap is locally known as 'casier' made from split bamboo woven into an open meshwork having apertures or meshes of 40 mm. The general form is that of a shallow six-sided basket of angular cordate shape, with a sleeve like funnel opening at the meeting point. Three types exist and used for different purposes. 'Casier Pese' set at low tide by on foot fishermen; 'Casier dormi' set further offshore (both soaked for up to 24 hrs); 'casier la Vole' set in the reef lagoon for spawning rabbit fishes (Short soaking time). No statistic is available on the number traps.	Siganides, lethrinides, lutjanids and Scaridaes	Usually inside reef lagoon and operating within 10 miles radius of any land. Day fishing. Fishing depth 5 to 30m.
Out-board	200-230	Includes all fishing boats powered by outboard engines greater than 25 Hp (up to 90 hp). This consists of vessels introduced in 1971 designed of fibreglass hull known as mini Mahè. Some boats vessels are now fitted with iceboxes extending the days at sea. Manned by 2-3 persons. Government no longer encourage these types of vessels to enter into the fishery (mainly the16 feet vessel). Their size has now increased up to 25 feet.	Handline, Fish trap and Gill nets (beach Seine and encircling gillnets)	Gill nets are rigged for two purposes: Mackerel and shark fishing. However, gillnet (Bottom set shark gillnets) for shark fishing was banned in 1998. The encircling nets for mackerel are constructed of monofilament or nylon multifilament with a stretched mesh size of 2.5 to 3.5 inches and hanging ratio of 0.5:1. Their maximum length is between 300 – 500 meters. The nets target mackerel and big eye scads and sometimes jacks. Beach seine is a technique whereby the net is drag over a sandy bottom pull in from the beach after being set at distant seaward from a pirogue.	All species but mainly demersal and pelagic.	Reef areas, banks and shoals up to 20-30 miles radius of land. 1 –2 days fishing. Fishing depth 10 –40 metres.
Whalers	50-70	Traditional whalers previously power by sails. Inboard engine were introduce in the 1950s and fitted). They are undecked and may have a small foredeck. This group now includes non-traditional designs such as the Lekonmie and Lavenir type vessels. The are also decked whalers fitted new equipment. Manned by 2 –5 persons. Fish capacity approx. 4 - 8tonnes	Handline and fish trap.	Handline (bottom fishing method) a rudimentary method favoured by most of the fishermen and involves hand lines armed with either two to six hooks with bait on traces, the line weighted with a lead or an iron sinker. Fishing depth (10 –70 meters)	Pelagic, demersal and sharks.	Mahé and Amirantes Plateau. Fishing trips usually last for 3-4 days
Schooner	10	Fully decked inboard powered fishing vessels fitted navigational equipments (compass, GPS and Fish Finder). A variety of design exists; Wooden and Fibreglass. Their sizes range form 7 to 18 meters in length. Manned by 4 to 10 persons. Fish capacity approx. 4 - 12 tonnes.	Handline, traps, gillnets, Loop nets	Gear used by this vessel category is mainly hand line. Electric motor for bottom fishing was introduced but never caught up due to limited spare parts and high maintenance cost.	All species Crabs (*Ranina ranina)*	Fishing range limited only by size of vessels and extreme weather conditions. Trip last up to 10-12 days.
Longline vessels	11	12 to 22 metre vessels powered by an engine in excess of 180 hp. More advanced than the local vessels and equipment navigational equipments. High capital investment.	Longline	Horizontal and vertical monofilament longlines	Swordfish, tuna, Sharks	Oceanic waters, varying fishing depth, fishing trip last for 6-15 days.

Complexity of Fisheries.

Within the context of fisheries, it is imperative to define technology transfer. Campbell and Hand (1998) conclude that technology transfer is fundamentally a complex process of learning and that is critical in fisheries given the level of literacy among fishermen. Chen (1996) argues that it is not unreasonable to say that a transfer is not achieved until the transferee understands and can utilise the technology. IPCC (2000) further notes that a test of this criterion would be the ability of the transferee to choose and adapt the technology to the local socio-economic environment and raw materials and improvements. This may be the best criterion to weigh the effectiveness of technology transferred in fisheries. However, a technology is unlikely to be adopted if the fishermen are unwilling to pay for it. Financial incentives are not the only enabling factors in technology transfer and adoption. It is in fact more complex and will usually reside in the interrelationship between the fishermen endeavours, socio-economics and the enabling environment.

Seychelles somewhat lacks certain key inputs required to fully exploit its natural resources in its Exclusive Economic Zone. It is the comparative advantage that generally dictates developing countries to import ocean technology which can accomplished through various means such as service contracts, turnkey operations, grant aids, technical cooperation, training, co-production agreements and joint ventures. Transfer of technology in Seychelles has been implemented using most of the pathways noted above but with varying success.

Technological innovation and transfer in fisheries in Seychelles is driven mainly by the fisheries developmental planning policies. Fisheries planning and development in Seychelles is geared towards mainly;

- Reducing uncertainty in the industry
- Fishing within ecological sustainable parameters
- Use of underutilised resources
- Stabilising returns from fisheries
- Improving institutional arrangements

Overall these objectives will govern what, which and how technologies are transferred and adopted in the domestic fishing industry.

Policy Context Analysis and Synopsis

Policy Context Analysis

Sectoral planning in Seychelles, originally through the formulation of 'National Development Plans' (NDP) has today been replaced by the 'Public Sector Investment Programme' (PSIP). The PSIP 1996-1998 (Anon, 1995) though outlining the activities to promote fisheries does not indicate the policies and objectives of the Government for their management and development. The most recent document, which describes them, is the National Development Plan, 1990-1994. Objectives related to the domestic fisheries were defined:

- To enhance its contribution to nutrition
- The creation of maximum amount of work opportunities
- The maximisation of foreign exchange earnings

- The creation of optimum linkages with other sector
- The insurance of stable development in the Industry
- The conservation of marine resources to ensure long-term viability of the industry.

Whilst the above policies may be still partially relevant, international organisations are more and more focusing on the conservation of fisheries through the harmonisation of policies. Albeit, the fisheries policy of Seychelles has however, evolved to be more conservative but on an ad-hoc basis. The Fisheries Policy is currently being revised to bring it in line with international convention and treaties.

In view of the nature of the Seychelles fisheries (multi-gear and multi-species), it is difficult to evaluate and even propose concrete policies, which could be used to mitigate on fossil fuel energy reliance unless part and parcel of the existing fisheries developmental programmes. However, the Seychelles Fishing Authority is being used as a clearing house to ensure that technologies being introduced is the most efficiency and economical.

Our fisheries also rely heavily on fossil fuel, which is partly subsidised by the Government. However, under the Macro Economic Reform Package being implemented in since June 2003 seeks to abolish the fuel incentives to fishermen. Invariably, the 'Seychelles Initial National Communication' made no specific reference on the consumption of fossil fuel in fisheries but bundled it together with agriculture. This will need to be addressed in the second national communication as fisheries is the largest consumer of fossil fuel (Artisanal and Industrial fisheries sector) The artisanal fishery per year consumes combined total of between 2.5 to 3 million litres of diesel and benzene per year. Presently there are no guides or definitive policies to mitigate fossil fuel reliance in fisheries and the technology may be prohibitively expensive. Controlling these emissions will be challenging because of technological and other constraints. What can effectively be promoted is the fishing vessels efficiency through the appropriate engine technology, fishing gear, fishing practices; information dissemination (environmental, stocks and education etc.) and resource management plans. One direction could the phasing out of 2-stroke carburetted engines and the introduction of fuel injected outboards which produces lower emissions and more environmental friendly. Fuel injected engines were introduced in the recreational fishery, especially the larger engines (>100Hp) but due to technical problems they did not catch on. Similarly, as fishermen usual mend their own engines a massive programme has to undertaken to transfer the maintenance and repair know-how.

The most important step in terms of technology transfer made by the Seychelles Government is the through Japanese Grant Aid Project to the artisanal fisheries sector. There have been other projects financed by the World Bank and African Development Bank (ADB) to upgrade the fishing capacity of the domestic fishing sector in an effort to increase the efficiency of the industry.

Table 2: Policy context Analysis within the dimension of enabling environment.

	Policy Dimension	Policies	Effectiveness	Gaps	Recommendations
1	**National System of Innovation for fisheries development**	Promote entrepreneurship in marine engineering and boat building and standards - efficiency of energy in design.	Reduce dependency on imports of purposely built vessels; Improve boat building	Capacity building and lack of boat building standards.	- Development of fishing fishing vessels building standards. Training in marine Architects and engineers.
2	**Increase the Social Infrastructure and participatory approach of fishers in policy making**	Promote fishermen's Association participation in the decision making process	Improve capacity and management skills within the social groups,	Improving professionalism in the domestic fishery.	Assist the fishing industry to form groups which would make TT more effective
3	**Human and institutional capacity for transfer technology**	Training in marine sciences and technologies, Develop institutional arrangements to facilitate training and fisheries management	Efficiency of fishing vessels needs improving, Reduction in the cost of fishing operations.	Lack of investment. The fishery has an ageing work force.	Analysis of fishermen income and local institutions
4	**Macroeconomic policy framework for fisheries sustainable development**	Sustained Income from fishing (Investment Promotion Act, Fuel Incentive Scheme, Soft loans).	Increased income for fishermen in the long-term and provide fishing technology at a reduced cost	Enforcement of subsidies, Sustainability of fisheries. Fisheries operating without large subsidies. Lack of economic evaluation.	Harmonisation of policies Reduce subsidies in the long term
5	**Sustainable markets for implementation of technology transfer**	Liberalisation of Subsidies	Free market Economic constraints for sustaining those markets	Lack of spare parts for technology transferred. Economic constraints Lack of Scientific and technical skills and know-how, Lack of resources and user awareness	Conduct Market Research. Increase involvement of the private sector. Improvement in the Enabling environment. Capacity Building. Sensitisation Programme
6	**Develop the national legal institutions to sustain appropriate technologies**	Sustained use of marine resources and fishing technology	Improved compliance	Lack of enforcements	Enforcement
7	**Codes, standard and certification for fishing technologies**	Promoting appropriate standard in the fishing industry	Enforcement of standards and certification	Rarely implemented in fisheries due to lack of awareness. Certification of officers.	Promote new codes and standards for fishery products
8	**Equity consideration for the fishing industry**	Access to credit, social benefits and access to efficient fishing technologies.	Increase in entrepreneurships. Increase investment. Increasing debts to borrowers.		Review policy Socio-economic impact study of fisheries
9	**Rights to productive resources**	Access to resources through appropriate management measures.	Reduce open access and Defacto rights.	Enforcement of fishery regulations. Inappropriate use of fishing technology. Irresponsible fishing practices	Review access to fisheries resources, development of management plan.
10	**Research and technology development for further development of the fisheries using efficient technologies**	Further the development of fisheries. Explore new resources. Introduce technology to target such resources.	New fisheries and targeting under utilised resources.	Management plans	Formulation of fishery management plans, new fisheries prospection.

Synopsis

As noted earlier in the report, adaptation measures are likely to be implemented only if they are consistent with or integrated with decisions or programmes that address non-climatic stress. This section draws lessons from techniques used to transfer technology in fisheries through a series of case studies. Though it may not be of direct relevance to mitigating climatic impacts, it has however, complementary effects in ensuring the long-term viability of the fishing industry in the midst of a changing the open ocean, coastal waters and resource variability.

The Seychelles domestic fishery is a multi-species and multi-gear fishery and fishermen have adapted to using different gears and target different species depending on resource availability and economic returns. Climate impacts on marine resources will no doubt affect the use of certain existing technologies. A change in the current level of temperature may alter fishing practices such that it minimises the efficiency of the fishing technology being used. Furthermore, vessels may have to venture further at sea and this requires fuel-efficient engines to reduce fuel consumption and also CO_2 emissions. It is therefore an overall objective of the Government to promote efficiency in the industry through its developmental objectives.

Case Study 1: Development of the Semi Industrial Fishery and the use of satellite imagery as an aid to fishing operations

Keywords: Semi-Industrial Fisheries, Seychelles, Longline, swordfish

Summary

This provided an opportunity for the fisheries to contribute to an increased output of food without putting any additional fishing pressure on the existing demersal resources. The fishery targets swordfish and tuna as the main species. The Seychelles Fishing Authority (SFA) introduced the fishery to potential entrepreneurs in 1997, following two year of extensive fishing trials. The fishing technique was already being used by the La Reunion fishermen targeting swordfish since the 1990s and proved very successful. It was realised that the development of such a fishery in Seychelles would return the same success, with a resource relatively unexploited excepted by the Asian longliners. To date, the fishery constitutes of 11 fishing vessels with the catch rising from 30 tonnes in 1995 to around 400 tonnes in 2001. The fishery is also a very important foreign exchange earner. In 2001, it earned the country US$ 2.4 Million. The fishery has recently been using satellite imagery (SST and Altimetry) extensively to improve fishing success. The success of this fishery has been made possible through the financial support provided from the French Cooperation, the EU, the Seychelles Government, the commitments of the Seychelles Fishing Authority to the fishing industry and also the fishing skippers.

Approach

This project developed and extended the fisheries production in view of the limited demersal fish stocks. In 1995 the Seychelles Fishing Authority carried trials to investigate the potential to development a longline fishery for swordfish in the Seychelles waters. The project proved viable (catch rates at 0.6 to 0.8 kg per hook) and investors were encouraged to venture into the newly developed fishery. Seychelloise skippers were trained in the use of longline fishing techniques and the catching techniques for the targeted species.

The Government of Seychelles secured financial assistance of a value SR 4.7 Million Rupees (750,000 EURO) from the European Union to further the development of the semi-industrial fishery and itself contributing 2 million Rupees per year. In addition, to date, around 15 young persons have been trained as fishing skippers and marine mechanic to support this growing industry. To further assist fishermen locate potential fishing grounds the Seychelles Fishing Authority in 2001, with the technical and financial assistance of the French Government, introduced the use of satellite imagery to assist fishing operations. Training of the scientists and fishermen in the use of the products was considered crucial to the transfer of such a high level of technology. The project due to end in 2004 costs around 400,000 SR. Fishing results and reports from the fishing skippers show that satellite imagery (Altimetry Charts) has greatly improved the success of their fishing operations though concrete scientific information is lacking to support their claims. However, SFA is undertaking studies to evaluate the effectiveness of such technologies.

An incentive scheme was also introduce in 1995 under the Investment Promotion Act, which provided fishing companies with favourable tax rates and financial opportunities to venture into such enterprise.

The Seychelles Fishing Authority was able to establish and demonstrate the value contributed by the new technology transferred to fishermen with the additional socio-economic benefits. Research and development is still going on in the semi-industrial fishery on how to increase the efficiency of the gear, especially through the use of Satellite imagery, hook timers and varying fishing operational techniques. The fishery is now being diversified to target specifically tuna and assistance from Japan and Spain is being sought.

Impacts

The development of the semi-industrial fishery and the introduction of satellite imagery has contributed significantly to food security in Seychelles. The Seychelles Fishing Authority is continuously encouraging entrepreneurs to enter the fishery, as it is presently the main fishery where potential for expansion is still sustainable. Fish production in this sector rose to approximately 450 tonnes in 1999 with 10 active vessels. Food security is seen as an important component to mitigate climate change.

Lessons Learnt

The fishery relied largely on subsidies (low interest rates, access to capital, duty free concessions) under the Investment Promotion Act for its success. However, the subsidy has been particularly effective in advancing the development and acceptance of the new technology without introducing hugh price distortion that can be associated with other types of subsidy. Support for research both within Seychelles and those from the developed countries have lead to significant innovations in the performance and commercialisation of the matured technology. The International community needs to recognise that parachuting new technology from the outside often does not work and international resources must involve and contribute to the national programmes to ensure appropriateness and transfer based on local ownership and existing institutions. Key lessons learnt is that any transfer of technology to the fisheries sector must be geared primarily to capacity building through training designed to upgrade technical, marketing and managerial skills and providing technical support to the industry. Though subsidies may be damaging in the long-term, it is somewhat necessary for effective transfer of technology in a developing fishery.

References.

Anon, 2001. Seychelles Fishing Authority Annual Report.

Case Study 2: Deep water Gillnet for Deep water Snapper.

Keywords: Deepwater Gillnets, snapper (*Pristipomoides spp.)*, fishermen, training

Summary

Fishing trial with gillnets targeting deepwater snapper was conducted in the 1990's with a view to establish the feasibility of this method and then transfer the technology to potential fishermen and boat owners. The trial was conducted with the assistance of FAO. The resource was perceived to have the potential to be a vital economic operation of the larger vessels 9-12m) in the artisanal fleet. The stock being targeted was under-utilised and would significantly contribute towards food supply and foreign exchange earnings. During the trial a total of 3, 900 kg of fish, 5, 600 Kg of sharks were caught giving an average catch per unit of effort of 24 kg/net/set for fish and 34.8 Kg/net/set.

The targeted species were the high valued deep-water snapper, *Pristipomoides sp*. Fishing were more productive when targeting the rim of the drop-off (60-100m) where the species is more abundant. Following the trials it was recommended that before the Seychelles Fishing Authority transfer the technology to fishermen it has to continue to identify the best fishing location, to modify the gear to obtain better holding abilities in the currents and promote better gear and handling facilities.

Even though it was agreed that the stock was being lightly fished, fishermen never fully adapt the technology. Fishermen noted that this fishing method through the gilling of the fish reduces quality, the by-catch was to high relative to the targeted species (composed mainly of sharks) and the high maintenance cost due to entanglement of the nets during fishing operation due to the topography of plateau drop offs. The high cost of the gear repairs and replacements made the operations prohibitively expensive for large vessels which already had high operating costs. Moreover, gillnets were non-selective gear and tend to fish indiscriminately.

Background

In an effort to increase the catch from the artisanal sector of the Seychelles from the present 4,500 metric tonnes to the estimated 7,000 estimated Maximum Sustainable Yield (MSY).
It was noted that any additional effort into the fishery should be channelled to exploiting the deeper water species on the rim of the Mahe Plateau.

The targeted species being predominantly *Pristipomoides* and *Etelis* species were considered to be under-utilised and exploiting this resource will remove at least some fishing pressure of the artisanal fleet on the inshore fishing zones. This potentially offered opportunities to the local fleet, in particular the larger vessels capable of fishing at long range to target these species. The Seychelles Fishing Authority constructed two 22 m vessel and a 12 vessel together with another three financed under the African Development Bank (ADB). These were three Cygnus multipurpose fishing vessels built in the UK to target these distant and deep-water resources between 60-200metres. Furthermore it was viewed as an opportunity to diversify and improve the fishing technology in the artisanal sector. There were no doubts that such technique will significant improve food supply and exports.

Approach

A key aspect of the unsuccessful dissemination process for gillnet technology in Seychelles is the degree that it has been socio-economically driven and it impact on resource users themselves. The gillnetting technology for deep-water snapper was a result of careful research on its design, fishing efficiency and patterns of usage to maximise catch. Training was key component especially for the skipper and fishermen on the SFA's research vessel and other interested fishing vessels. However, the economic returns were not visible.

It is the objective of the Government to venture and experiment with new fishing technology and target untapped resources. Whether resource users will take it up the technology is another issue. Around six vessels were equipped with the necessary equipments (net hauler, etc.) to take up the technology but never developed any further and were eventually dropped.

Impacts

The bottom gillnet was very effective in targeting deep-water snapper, though the majority of the catch consists of sharks which had little commercial value except of its fins. Though the stocks were known to be under-utilised, fishermen argued that the fishing method was overexploiting the stock, a destructive gear and yielded poor quality and a low-grade fish for exports. There was also an apparent conflict between the handline and gill-netters due to non-selectivity and 'ghost fishing' concerns of the nets.

Lesson Learnt

Many have noted that the transfer bottom gillnets for deep-water snapper was a failure. However, others have considered the trial to be part of an ongoing policy to research appropriate gear technologies to exploit the untapped marine resources. However, despite

these conflicting views on bottom gillnet fishing for deep-water snapper, domestic fishermen never adopted the technology. The gear technologists and fisheries planners may have

neglected to consider how the resource users will perceive their innovations and whether they are likely to be successfully in solving the problem the industry were facing.

If a technology or innovation is complex and it costs and expected returns are difficult to identify, and the adoption challenges the fishermen beliefs, communication from researchers to fishermen must be extremely clear or adoption is unlikely to occur. There are numerous reasons why fishermen do not always adopt new technologies or innovations.

Economics, social and environmental benefits provide the platform from which the fishermen make its decision of whether or not to adopt a technology. Fishermen are extremely good at weighing the cost and benefits of their operations.

Translating the concerns of fishermen and other stakeholders regarding the sustainability of fishing operations or activities, into action, is a key challenge for fisheries planners.

Environmental and social impact, like safety at sea, fish quality and business issues, needs to come part of the decisions making process when deciding on whether or not to adopt a technology. Cost-benefit analyses need to encompass the triple bottom line (economic, social and environmental performance), along with safety and quality.

Technology transfer is more readily accomplished between cultures that share similar attitudes and uncertainty avoidance.

References

Bean, C. C. 1991. *Gillnetting trials for Deepwater Red Snappers on the Seychelles Plateau*. FAO/UNEP RAF/87/008/DR/63/E, 15p.

Case Study 3 Modernisation of the artisanal fleet

Key words: Seychelles artisanal fisheries, modernisation, Grant Aid, government, fishermen

Summary

It has long been recognised, except for highly migratory species (Tuna, swordfish, etc) that the potential for further development of the Seychelles fisheries relate principally to the exploitation of demersal resources in areas distant from the centre of the population. This includes both the traditionally harvested shallow water demersal species, and the present lightly, or unexploited deep reef slope species. Near shore demersal and reef species are already fully exploited. Some potential however, exist for expansion in the pelagic fisheries notably mackerel and jacks, but there is a seasonality and a market constraint.To target the untapped resources the modernisation of local artisanal fleet was necessary. The modernisations of the fleet included both the international cooperation and the critical commitment of local resources to succeed which proved to be an important contribution to increase fish production, foreign exchange earning for food security.

The programme provided multipurpose fishing vessels, engines, fishing and navigational safety equipment. It is evident now that almost all of the 460 fishing vessels in Seychelles are now mechanised and using the latest engine technologies and post harvest technologies to exploit the marine resources and thus contributing to food security. However, the post harvesting technologies still needs to be improved.

Approach

Much of the success of the effort hinged on the commitments of the Seychelles Fishing Authority with the assistance of the Japanese Government to modernised the fishing industry to be able to cope with a growing population, declining coastal resources and potential climatic effects. The Grant Aid from Japan to the Seychelles in 2000 was in the range of 30 million Seychelles Rupees.

The project was multi-faceted and involved a grant from the Japan Government, which included marine engines, fishing gears, navigational equipments, safety equipments, ice making facilities and purpose fishing vessels. It was critically important to understand that within the present economic constraints, the project provided an improvement to a much needed technology in fishing industry. There was no real commercial consideration here. Although the equipment and fishing vessels were sold, it was done so at a subsidised rate and the funds were ploughed back into the industry to fund minor projects such as small research programmes and renovation of fishing facilities.

To ensure that that the engines are fitted correctly the SFA provide the engineering services free of charge to boat builders. Guidance was also provided to fishermen in the maintenance of their engine, as these were more of an advanced technology. Training in the use of fish finding equipments and navigational equipment were also provided to potentially enhance their fishing efficiency. A majority of vessels are now targeting resources distant from the centre of population uses extensively such technology. The SFA was able to demonstrate to the Japanese Government the value of modernising the artisanal sector and the technology transfer in the aid to render fishing operation more efficient and profitable. To sustain these technologies the Government also established formal and informal agreements with commercial enterprises to continuously provide support for these technologies.

Impacts

The impact was a relative increase in fish production from fishing grounds further from the centre of population. Fisheries production showed only a marginal increase but with ice making facilities the landed fish was of greater quality and thus attracted a high price on the international markets. With an increase in efficiency of engine and availability of fishing equipments fishermen found that identifying potential fishing grounds improved. During the period the revenue from fisheries increased so did the value of exports as post harvest technologies (such as icing techniques) improved considerably and also the availability of ice for fish preservation. The standard of safety and on board living conditions were improved considerably.

Lessons Learned

It is critically important that for technology transfer to be successful there must be supported institutions with a primary objective to ensure that is successfully transferred. The Japanese Government through their Grant Aid Project provided the resources but the transfer of technology depended largely on the users, institutional support, adaptability of technology, training and the confidence of fishermen in SFA. Subsidies are equally important in facilitating the uptake of technology as it directly reduced the up-front capital cost.

However, subsidy can also be problematic tool, such as encouraging inappropriate technologies within a fishery and potentially increasing fishing effort through a rise in the horsepower (fishing power). The introduction of outboard powered motors in the 1970s, which now represents over 50% of the fishing fleet, overexploited the near shore resources is a clear case.

The Seychelles artisanal fishery is a complex industry with the fishermen having a limited technical knowledge. An understanding of the socio-economic attributes of the industry and the institutional arrangements at local level is crucial for any transfer of technology.

References:

Payet, R. (1996). Artisanal Fishing Boats of Seychelles.

Assessment of Technology Options

Technology options

Technology options for fisheries are limited and complex. Anthropological studies have on numerous accounts confirmed that artisanal fishermen usually find it difficult to adopt new fishing technologies. Fishermen have a slow rate of change and this makes it difficult for fisheries technology to get fully adopted. However, the driving force that might reverse this trend is the probably climate impact on marine resources and availability fish to fishing gear (catchability of the gear). IPPC (2000) noted however, that the ability to adapt and cope with climate change impact is a function of wealth, scientific and technical knowledge, information, skills, infrastructure, institutions and equity. The only viable technological option for fisheries is increasing the efficiency of fishing operation through the transfer of appropriate gear, engine technologies, information access, research and fisheries management. These are ongoing objectives of the Government with regard to fisheries. While the climatic impacts on fisheries especially demersal resource are difficult to assess, technology options

can only be assessed through the existing fisheries developmental and management policies. For example, the use of echo sounders, GPS, has drastically improved fishing efficiency and better utilisation of the fisheries resources.

The technology options proposed in the National Communications are:

"Adaptation of fish distribution with better fishing techniques. This is achievable with the use of satellite, faster vessels (better design), on board storage and onshore infrastructure."

This can be broken down into six potential technology transfer options to mitigate climate change impact on fisheries.

i. Satellite information/communication technologies (safety at sea)
ii. Fishing Gear technologies
iii. Efficient fishing vessels (engines, vessel design)
iv. Fish Storage capacity (cold storage)
v. Post Harvest technologies
vi. Onshore infrastructure

Table 3 indicates the various actors and their roles in the technology transfer for the fishing industry as a prerequisite for successfully technology implementation.

Stakeholders Issues

Stakeholders concerned with technology transfer in fisheries are notably, fishermen, fish processors, boat owners, service providers and the government. Fishermen, boat-owners and processors are the most concerned about the use and the transfer of the technology in fisheries. Technology in fisheries is limited to these three groups. The Seychelles Fishing Authority has more or less been the main body transferring technology into the domestic fishing industry. As Technology transfers are usually matured technology there is little feedback mechanism to the developers unless under warranty. As SFA has vested interest in the sustainable of the fisheries technologies is somewhat burdened with ensuring an appropriate feedback mechanism which could well be taken up by the private sector. The SFA also acts as the clearing house of technologies being introduced into the domestic fishing industry. There is though, a general lack of interest of the private sector in fishing technologies.

Fishing gear technology has not evolved that much over the past 20 years. The majority of fishermen still favour handline and traps, though some have opted for more advance and efficient fishing techniques such as dropline and longline methods. Some of the methods were often introduced without sufficient regard for the prevailing social systems, economic conditions, the indigenous knowledge base and natural resource constraints.

Technologies in the fish-processing sector have developed quite extensively. The development are mainly in cold storage and ice making facilities. These developments have

been advanced by market pressures especially from the European Union with regard to the HACCP guidelines.

Stakeholders in industry are becoming more aware of potential effects of climate and it important that any technology, the transferor should be sensitive to the needs and problems of the user groups such it can be built into development activities so that these problems can be minimised (e.g. conflict with social systems).

Local markets and Needs

Markets of sustaining technologies are very limited for fisheries in Seychelles. The local market is very small and often unable to sustain the technology to due unavailability of parts, lack of information on new technology, out dated and redundant technologies, economic constraints and social preferences. There are approximately 20 different brand of engines-make in Seychelles given the size of the market. There is certainly a high transaction cost to some of theses brand names. They are more often driven by the private sector, which tends to opt for cheaper technologies. There is also a lack of confidence in the economic, commercial or technical viability of the technology. For example most fishermen would not opt for a four stroke outboard engines in simple terms that it is technically too complex, lack of skilled personnel and high initial and repair costs.

There is a need to conduct education and outreach campaigns to fishermen and other stakeholders for effective use of fisheries technology and which is critical for the sector. In addition the sector required the following to enable to mitigate climate changes.

- Engine efficiency
- Proven Engine technology with minimum cost and emissions
- Sustainable fishing techniques
- Educational Programmes

Needs and Demands for the Future Markets

The Seychelles Fishing industry is a sector that relies heavily on already developed technologies. It has been pointed out that maturity of a technology will affect the degree of success of technology adoption. Industrial standards emerge when the technology becomes mature. It therefore critically important that the demands for technology are guided toward mature technology options.

Needs and demands will intensify as climate impact becomes more visible. There will potentially a need for more efficient but environmental friendly fishing techniques, information on stocks abundance and location using the satellite imagery, larger fishing vessels with bigger holding capacity, more efficient marine engine (four stroke outboard

engines etc), better vessel design and advance post harvesting technologies such as fish processing. The future challenge to those working in fisheries will relate to improving both the effectiveness and efficiency of technology transfer and adoption, with limited funding available, and ensuring that those technologies adopted will be sustainable. Policy makers, key stakeholders in shaping the legal context in which the technology will transfer and adoption occurs, as well as business, therefore needs new measures of progress towards adoption of sustainable technologies.

Within the context of existing technologies, the technology options are already matured and expect not to provide any major difficulties to transfer in fisheries. The opportunities presented by these technologies in view of food security will only be realised if support by national policies and programmes and capitalised upon by local and international development agencies. Other practices such as the transfer of standard technology without knowledge of local conditions and the importation of large-scale turnkey projects could have negative environmental and social consequences and could threaten food security.

The weakness, gaps and constraints to technology in fisheries are broadly experienced in five main areas (Table 4). First, the suppliers of equipment are not available locally. Lack of skilled specialist and the frequent use of foreign agents increase the transaction costs. Second, the labour market lacks skilled personnel. Third, the market forces divided into materials and final products faces shortages of supplies and shifts in demand. Fourth the government approval for technology transfer and the lack of standards to enforce quality in technology make it difficult to obtain better services and fifth R&D facilities are limited to deploy technologies transferred.

Table 3:Major Actors and their role in the Transfer and adoption of Fishing related technologies.

Seychelles Fishing Authority or another Executing Agency	**Government**	**Users, Researcher, Processors**
Technical, institutional and socio-economic assessments	Facilitate the collection of Information	Adaptation and adoption of technology
Advice to the Government, users, researcher and Processors	Support to |research institutions	Application of appropriate quality control and quality assurance measures
Provision of information	Provision of incentives to the fishing industry	
Promotion of sustainable use of technology and dissemination		
Transfer of appropriate level and scale of technology	Institutional support	
Provision of training in the use of technology and in marketing	Provision of infrastructural support	
Facilitating the adoption of the technology	Facilitate access to and dissemination (loans subsidies)	Acquire technology

For technology to be successfully transferred in fisheries the existing constraints will have to be addressed. It is common for the Government and private corporations to find it difficult to continuously finance and provide incentives for technological developments and transfer

without a fair return. The support of R&D required for effective technology transfer is limited by diminishing research funds. Diminishing funds for R&D is a constraint to the development and transfer of technologies in the fisheries sector.

Table 4: Gaps, Weakness and Constraints to Technology Transfer in the Domestic Fisheries of Seychelles

Equipment Supplies	Labour	Labour markets	Market Material Supplies	Final Product	Government intervention	R&D Facilities
No dedicated supplies and skilled specialists	Government policies to reduce expatriates	Lack of Skilled Labour	Input shortages	Producers relies on imported products Reliance on fake and cheaper products.	Lack of standards for enforcement	Lack of tools, specialist in local R&D.
Few links with suppliers and tools innovators	Lack of participation of local private sector	Few marine and electronic engineers		Large shift in demand depending on products types		
No local manufactures	No Skilled labour	Inadequate local education and training provisions	Difficulty to obtain raw materials	Government's influence on markets and prices	Difficulties in getting the required services	
Technology transfer dependent on external/foreign grants			Lack of parts		Limited assistance scheme s	Limited government programs
Local supplier inability to supply the market			Difficulty to access financial resources	Customer preferences usually for matured and older technology	Few public sector experts Weakness in extension work	Range of facilities limited, poor equipment, legal financial, technical and consultant services.
Inadequate financial arrangements			Limited access to foreign exchange		Lack of subsidies	
Sustainability of old technologies		Lack of skilled labour	Discontinued material, to many brands		Policy to control untested technologies	Lack research to replace new and more appropriate technologies.
High cost and low quality of tools and parts						

Implementing Technologies

Technology transfer in fisheries is a complex affair. Transfer of technology to fishermen situated in developing countries requires special skills. It integrates four generic technology types such as human beings, know how, physical objects and techniques. Institutional, market and human resources factors are important to the transfer of technology and capacity in the fishing industry.

At present the domestic fishing industry relies heavily on the government to supply technology. The following recommended actions will enable the fishing industry ease constraints to technology transfer.

- The government should build strong relationship with promoters in the private sector.
- The private sector should then generate sufficient financial and technical capacity, and be liable for reduction of emission, must observe environmental safety regulations and enhance transfer in the fishing industry.
- Implementation of the technology transfer of should be in manner that does not disrupt local cultural trends.
- The transfer of technology needs to be functional without elaborate supporting devices or infrastructure.
- More aggressive approach in education of technology for fishermen/fishing industry

Table 5 indicates the key socio-economic, legal and capacity needs to determine the best potential for technology transfer. This is very complex. For example cost and benefit analysis was considered to be common need to ensure successfully implementation of technologies, whilst the purchase of patent and licenses was not major need to implement most of the technology options.

Moreover, new approaches that amalgamate the capacities of research and extension to form technology development and transfer entities that work with smallholders to develop and disseminate information have been recognised as crucial. Appropriate training in participatory approaches can also assist target projects towards the needs of the fishing industry.

Table 5: Matrix of key socio-economic, legal and capacity needs.

	Satellite information	New fishing gear technology	Efficient fishing vessels	Fish storage capacity	Post Harvest technologies	Onshore infrastructure
Infrastructure availability for TT[1]	•	•			•	•
Skilled labour to monitor and implement TT	•	•	•			
Financial resources to implement TT	•	•	•			•
Credit availability		•	•	•	•	•
Lack of access to information for effective TT		•			•	
Purchase of patents and licenses on commercial terms for their transfer to developing countries on non-commercial terms, as part of development cooperation for sustainable development	•		•			
Requires large investments and national technology and assessment commitment	•	•	•			•
Institutional mechanism needed to facilitate TT	•	•			•	
Development of standards			•	•		•
Research and development facilities	•	•		•	•	
Educational and skills development	•	•			•	
Capacity of social organisation (fishermen Association) to facilitate appropriate TT	•	•	•		•	
Community strength to accept new trends in technology	•	•			•	
Cultural integrity, educational gaps and literacy in the fishing industry	•	•	•		•	
Coast and benefit analysis for TT	•	•	•	•	•	•
Management experience and skills		•	•		•	
Limit impact of technology because no long-term capacity built to maintain innovation	•	•	•			
Subsidises	•	•	•		•	
Strengthen legal fisheries institutions to reduce risks		•	•		•	
Sustainability of the technology	•	•	•		•	
Assessment of needs for TT	•	•	•	•	•	•
Safety issues		•	•		•	

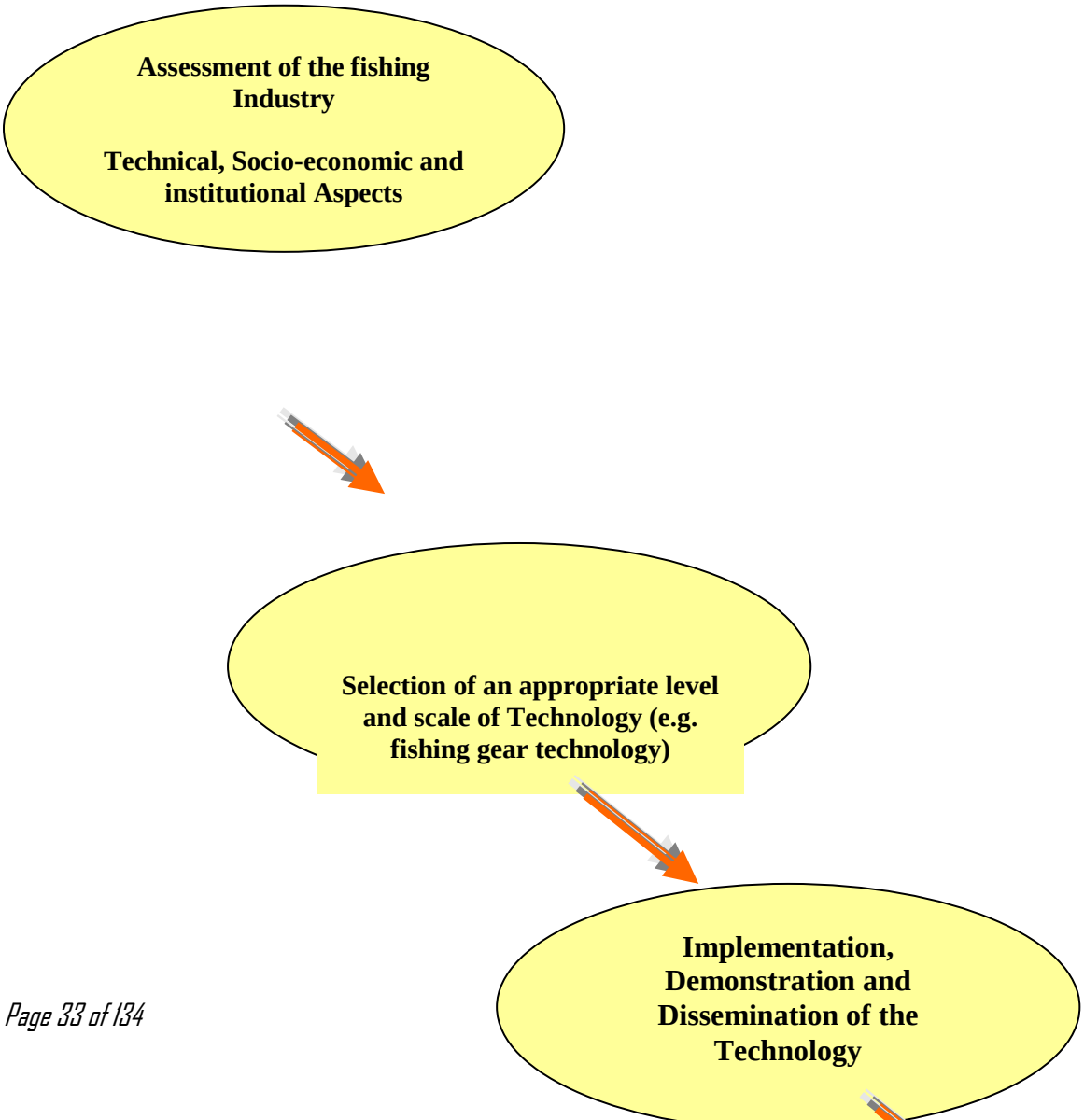
[1] Technology Transfer

Criteria for Effective Technology Transfer

A considerable amount of hard work and commitment are involved in the transfer of technologies to the fisheries sector. Experiences from the sector have shown that individual preferences, rather than technical criteria dictate the adoption of technologies and their products in Seychelles. Thus, any technologies selected for transfer must grow out of needs and practices of the fishing industry. The level of technology and tools transferred must conform to both the sociocultural environment and to the available resources. This is critical for the both the domestic and the industrial fishery. Whilst it may difficult to assess the level in technology transfer in the foreign fishing industry, it is critical to be able to quantify the effects of the technological developments in relation to increased fishing power and its potential effect on the tuna stocks.

A properly coordinated systematic approach for technology transfer in fisheries might constitute of a four-phased approach: assessment of the fishing industry situation, selection of appropriate scale and level of technology, implementation, demonstration and dissemination of the technology and the facilitation of access to the technology (Fig. 1). This is believed to be very critical for the fishing industry.

Figure 1: Approach criteria to sustainable technology transfer in the Fisheries Sector (Adapted from Rolle and Satin, 2001).



This four-phased approach however, must be taken with the objective of being both economically and socially appropriate.

Assessment of the Fishing Industry

Fishing communities in Seychelles are a homogenous group, and vary greatly in their technical capabilities. Thus prior to the transfer of any technology to the fishing industry, an assessment of the technical, socio-economic and institutional conditions within the recipients in order to evaluate the level and scale for the technology to be introduced and potential for gear, engine technologies and processing and its products to be accepted. The logistical aspects of the industry, that is, supporting infrastructure, markets to sustain the technology, access to parts and raw materials must be assessed. Socio-economic assessment is conducted in order to evaluate the level of organisation within the fisheries sector, cost and availability of labour, fishermen preferences, consumer purchasing power, and acceptance of the products.

Institutional factors play a major role in the successful establishment and functioning of small-scale fishing enterprise. Institutional assessment must incorporate the level of education within the industry, locally available skills and technical supporting services, along with an assessment of the capacity for research and development by the executing agency.

Selection of Appropriate scale and level of technology

Having thoroughly assessed the needs of the fishing industry, the scale of the technology will depend on the assessed demand of a fishery and will in turn govern the type of fishing technique or equipments to be required. Emphasis should be placed on self-reliance in the selection of appropriate technology. Equipment that can be locally maintained, with relative easy access to spare parts, is generally highly desirable. Technologies, which uses locally available materials and skills that can be developed within the country, is most desirable for transfer and adoption in light of the high cost of foreign exchange. In addition the technologies must have credibility and show clear benefits such as availability of resources, financial profitability, social and environmental benefits.

Implementation, demonstration and dissemination of technology

This is accomplished through training in forms of workshops and demonstration of the technology. Demonstration of the fishing techniques is crucial for the technology to be accepted and tried. Mechanism for dissemination of the technology will be largely depended on the educational level and the enabling environment (media, radio). These are necessary, as they will upgrade the technical skills of the fishermen.

Facilitating Access to technology

Experiences in the fishing industry of Seychelles have shown that the adaptability of any technology is highly dependent on the recognition by the fishermen, of a clear benefit in the use of the technology and its products. Once adopted, it is may be necessary to facilitate entrepreneurs in acquiring the technology and the development of their enterprise. Often, it is necessary to make available certain financial credit facilities and subsidies to allow the technology to be acquired. Whilst this may important for technology transfer in fisheries, it does not come without its costs for fisheries resource management.

Stakeholder Typology

Table 5: Summary of stakeholders in the fishing industry.

Stakeholder	Description
Sources and Developers of Technology	Fishing technology in Seychelles are usually import from developed countries and developing countries which have experienced the success of the technology. For example longline fishing for swordfish has been practice for many years in developed countries. The success and availability of the resource has made it possible to adopt such fishing technology. The also applies for fishing finding equipment such as echo sounders, GPS etc. Overall all sources of technology are from Research and Development Agencies in developed Countries.
Owners and supplier of technology	Technologies in Seychelles are usually owned and supplied under a licence from the proprietors.
Buyers of Technology	These are usually boat owners, fishermen or entrepreneurs and the general public.
Financiers of Technology	This usually falls under the responsibility of mainly the Government and other lending private agencies. In the Fishing Industry, technologies are usually financed by the Seychelles Development Bank, the SIDEC through the Youth Enterprise Scheme (YES) or through arranged bilateral agreements.
Information providers	Information on technology are usually undertaken by the Seychelles Fishing Authority with assistance of UN organisation such as FAO, JICA etc.
Market Intermediaries	These are usually governed by the availability of a technology. Seychelles has a very small market for fishing technologies, thus very selective.
Governments	The Government plays an important role in introduction of fishing

technologies. To ensure that technology are economically feasible and has environmental benefits certain restrictions are enforced (gillnets for shark fishing banned in 1999). The Government also ensures that there is an enabling environment through which technology can be effectively transferred.

Conclusion

The tainted cry for technology has once been again been raised within the climate change context. In this regard, there is no denying that both development as well as transfer and wide scale deployment of appropriate greenhouse abatement technologies is endemic and critical to any successful action on climate change. The fisheries sector of Seychelles is very dependent on fossil fuels and considering green solution might be prohibitively expensive. However, technology transfer is, undoubtedly growing to be one of the key vehicles for climate change mitigation in the fisheries sector.

It critical to ensure the transfer of technology to the fishing industry is not based on 'beggars cannot be choosers syndrome' where scant attention is paid to local assimilation and adaptation of the technologies. Therefore the fishing industry should be aware of contingent and conditional aid packages have includes technologies not always appropriate or the most effective for the industry.

References

R. J. Payet, 2000. *Institutional Analysis: The Seychelles Artisanal Fishery*. University of Portsmouth, Masters Thesis. Pp. 99.

IPCC, 2001**.** *Climate Change 2001. The Scientific Basis.* http://www.grida.no/climate.ipcc_tar/wg2/049.htm.

Campbell, H. F and A. J Hand. 1998. Joint Ventures and technology Transfer: the Solomon Island pole-and line Fishery. *Journal of Development Economic*. Vol. 57: 421-442.

Government of Seychelles. 2000. *Initial National Initial Communications under the United Nations Framework Convention on Climate Change*; Ministry if Environment and Transport, Republic of Seychelles.

Anon, 2001. ***Seychelles Fishing Authority Annual Report 2000***. Pp. 66.

3. Assessment of Technology Transfer in Land Use, Land Use Change and Technology Transfer

Author: Francis Coeur-de-Lion

Introduction

Technology transfer in Land Use, Land Use Change and Forestry (LULUCF) sector provides an important opportunity to help mitigate climate change. Furthermore it helps in adapting to potential changes in the Technology Transfer Strategies of the Land Use and Forestry Sector for promoting mitigation options. Apart from reducing greenhouse gas emissions or enhancing carbon sinks this sector has the potential to provide other tangible socio-economic as well as local and global environmental benefits contributing to sustainable development. Technology is a vital component of the LULUCF Sector in mitigating climate change. This chapter will look at certain options and discuss the parameters that are needed to adopt such technologies. Furthermore this paper will focus on issues like barriers to technological transfer, capacity to use and maintain the technology as general forest protection and management.

The term ‘ technology transfer’ is defined by the Inter-governmental Panel on Climate Change (IPCC) as a broad set of processes covering the flows of know-how, experience and equipment for mitigating and adapting to climate change amongst different stakeholders such as government, private sector entities, financial institutions, non-governmental organizations (NGOs) and research/education institutions.

The broad and inclusive term ‘transfer’ encompasses diffusion of technologies and technology cooperation across and within countries. It covers technology transfer processes between developed countries, developing countries and countries with economies in transition, amongst developed countries, amongst developing countries and amongst countries with economies in transition. It comprises the process of learning to understand, utilize and replicate the technology, including the capacity to choose it and adapt it to local conditions and integrate it with indigenous technologies.

The terms “land cover” and “land use” are often confused. *Land cover* is “the observed physical and biological cover of the earth’s land, as vegetation or man-made features.” In contrast, land use is “the total of arrangements, activities, and inputs that people undertake in a certain land cover type” (FAO, 1997a; FAO/UNEP, 1999).

Forests are usually composed of many individual stands in different stages of development and with different characteristics. Thus, a forest can include a range of different forested ecosystems composed of different species and different ages and having different carbon stock densities (t C ha^{-1}). In this Special Report, the term forest refers to the whole forest (as a landscape), including its forest stands (its component units). The term stand is used where necessary for clarity. Many definitions of forest are

in use throughout the world, reflecting wide differences in bio-geophysical conditions, social structures, and economies. Lund (1999) listed about 240 such definitions. Most countries have developed very specific definitions that are suitable for their own administrative purposes and reflect their forests' ecological conditions. In seeking a set of definitions for the Protocol, it must be recognized that many national agencies have invested significantly in databases that are founded on their own definitions. (IPCC).

"The total area covered by forest is approximately 3 866 million ha, almost one-third of the world's land area, of which 95 per cent is natural forest and 5 per cent is planted forest; 17 per cent is in Africa, 19 per cent in Asia and the Pacific, 27 per cent in Europe, 12 per cent in North America and 25 per cent in Latin America and the Caribbean." (Global Environmental Outlook 3 (GEO 3), 2002, Page 91). According to Seychelles Forestry Management Plan of 1993, the total forest area for Mahe, Praslin, La Digue, Curieuse and Silhouette was 17,600 hectares which is 78 % of their land area.

In this report no distinction has been made with regards to technologies within countries i.e. those that can be transferred from one place to another and technologies between countries i.e. Seychelles and other countries. This is because the technologies overlap for example a technology can be transferred locally without any problem. The implication is that there are factor from outside the country e.g. training which will come into play.

Policy Context within Framework

This section deals with the policy issues with regards to technology transfer in the Land Use, Land Use Change and Forestry Sector. The tables which follow present the policies, their application, their effectiveness, problems and proposal/recommendations.

Policy Dimensions	**Applicable policies currently in place**	**Effectiveness of these policies**	**Gaps in those policies**	**Proposals/ Recommendations**
National systems of innovation	Use on cleaner technologies e.g. levy on Kerosene (policy) to get people to use LPG/use refrigeration appliances using less CFCs.	Tax on kerosene/consumers encouraged to buy LPG and the trend lead consumers to use gas cookers/get importers who do not comply to return those products.	Tax do not force people to use gas stoves, a gradual ban on kerosene could solve the problem in the long run/in the case of CFCs strict laws needs to be in force with no compromise.	Subsidies LPG – make it cheaper/continuous campaigns/discourage consumers to use kerosene/in the case of refrigeration educate importers & the public as well drafting laws.
Social infrastructure and participatory approaches	Encourage the population to participate in the decision-making process e.g. commenting in EIAs/meetings.	Population is encouraged to participate. Most emphasis is placed in schools so that when these pupils become adults they already have that understanding.	These are not strict policies forcing participation.	Show population the benefits of commenting and the importance of their involvement.
Human and institutional capacity	National training policies to get the skilled people required (MAM)/Each ministry/parastatals and private sector has developed their own capacity in their respective fields.	MAM is trying their best Government through the Ministry of Education has a policy of sending a certain number of students abroad to train while local training is still being conducting even though at a specific or lower level.	Skilled people are not necessarily those needed in matter pertaining to climate change and environmental issues. Also trained people tend to look for better deals all the time and do not stick to one type of job.	Should look at human resources more closely/recognize the importance of climate change. Have enough incentive for employees to stay in their job and develop the career concept among young people.
Macroeconomic policy framework	Macroeconomic policies do exist to facilitate ensure an enabling environment e.g. fiscal and monitory policies, trade.	Facilitates local and international trade by making available certain amount of funds, tax concessions.	Policies have to be more focused on tech-transfer especially in trading between countries which will also facilitate emission trading if the country ever gets involved with it.	Financial support and foreign exchange facility, equitable terms of trade, concessions where applicable.

Policy Dimensions	**Applicable policies currently in place**	**Effectiveness of these policies**	**Gaps in those policies**	**Proposals/ Recommendations**
Sustainable markets	E.g. LPG where government ensure its use through guaranteed import of the product, incentive in LPG appliances	Policy works as long as the supply is guaranteed	Too reliant on LPG, should look for other alternative. This should apply for any technology being introduced.	Find other alternatives through market research & on the supply side as well, explore renewable resources
National legal institutions	Not strictly towards tech-transfer but the existing legal framework indirectly do cover process and facilitate various transactions applicable under tech-transfer.	The policies are quite effective but more monitoring is necessary because the regulations can be bypassed.	Since policies are not specific to the topic it can be very difficult to try and relate existing policies with tech-transfer.	Have a specific institution with appropriate laws to deal with this issue.
Codes, standards and certification	This exists but not specifically for tech-transfer though it can cover certain aspects of it.	In technology already transferred this issue has been addressed but whether they are being applied is not easy to say. Also the codes, standards and certification are too complicated/difficult to understand.	Certain people have claimed that the procedures are very long, difficult and sometime the standards are so high that they do not want to carry on with a project.	Needs to be not to long/difficult, implementers need to have enough information about them and know what is expected of them
Equity considerations	Policies in all sectors tend to promote equity in general	No policy exist to monitor whether equity is applied	People ask that they get and fair share and treated equally/this has not got do with any policy however.	The concept needs to be understood by all and also a body could look at this issue if necessary.
Rights to productive resources	Governmental policies ensuring allocation of properties as not to affect future needs/gives opportunities to potential developers/implementers	Government though ministries is doing a lot of work to manage productive resources under various mechanism.	Ownership right overpowers attempts to retrieve potential areas and ultimately acquisition is used.	Introduce more legislation to reduce barriers to obtain productive resources. Also do more research to locate more productive resources.

Research and technology development	Technologies exist e.g. in IT/GIS but no policies on data usage.	Policies need to be formulated and implemented.	Need to formulate policies first.	Encourage R & D to enhance skills, train the trainers, and establish a technology centre that will act as a centre of gravity for all technology available in the country.

To show the importance and impact of a technology in LULUCF it is very important to illustrate the findings with some example. Two case studies have been utilized, one showing two ways of adopting technology which have an effect on forest cover and carbon sinks. The first case study deals with the monitoring of removal of vegetation by the Town and Country Planning Authority shown here as a success. The second case study shows how forests can be destroyed causing not only harm to vegetation (carbon sinks) but also having an impact on socio-economic side as well. It also shows the effectiveness of humans when dealing with such catastrophes.

Case Studies

Case Study 1 Monitoring of vegetation removal through the Planning Authority (PA)

Keywords:

Planning Authority, vegetation, permission

Summary:

The Planning Authority is a national Government body that regulates all development in the Seychelles. Its members come from most ministries while others from agencies. Before any development is undertaken a plan must be submitted to be considered. According to the PA's judgment a development is approved, refused or differed, whereby the developer needs to add more details.

Approach:

Under the Town and Country Planning Act each developer needs to fill in an environmental form. In one area of the form the developer needs to state the type of vegetation on the property and whether the vegetation needs to be removed.

The form then is attached to the other documents of the whole application and The Ministry of Environment (MOE) (which sits on the PA) send the technicians on the site for inspection and gives a feedback. MOE does not just approve or reject but advise the developer for example not to strip the land bare but leave as much vegetation as possible for e.g. soil protection and so on.

Impacts:

At first people where not to happy about the idea. The argument was that 'why do I need to seek permission to clear vegetation on my own land'. Explanation from both, the Ministry Of Land Use and Habitat (MLUH) as well as MOE together with the use of the media help people to realize that vegetation plays a big role in people's life and that it has to be preserved for the generations to come. Furthermore the knowledge about desertification in other countries makes citizens to come closer together and protect the natural environment. Some developers do not abide to the rules but at a certain stage of the development building inspectors go on site and can therefore check whether the developer has obtained permission to clear the land. If not appropriate action may be taken.

In an economical the Seychelles do not have to invest extra money for reafforestation, which can be very costly e.g. purchasing of seedlings, fertilizer, transport and manpower.

In the climate change context instead of burning trees just to clear the land the vegetation stays in its natural habitat and carbon dioxide is not emitted in the atmosphere. As a result there is more carbon sinks, which may be utilised in Emission Trading.

Lessons Learned:

This method of protection proved to work because

- First of all it is being implemented by a body that has the mandate to exert its power.
- This has been a success story because the Seychelles has very strong policies regarding the protection of and embellishment of the natural environment thus citizens have to abide to the regulations.
- Educational programs in schools, on television and in the papers increase the awareness and people get use not to destroy nature.

Case Study 2: Bush fire at Fond Boffay on Praslin Island, Seychelles.

Keywords:

Bush fire, forest, species

Summary:

A bush fire broke out at Fond Boffay on Praslin Island on 18th July through to 20th July 1999. The fire destroyed 20 hectare of dense forest and the species most affect were

Coco-de-mer palms and Latanier. It was not possible to establish whether the cause of the fire was a malicious act and a police investigation was launched to determine the real cause while three people were arrested.

Approach:

As soon as the fire was discovered all the personal concerned were alerted. The party involved had to climb the sloppy as well as flat terrain up Mount Jenny, Pointe Cabris. The deployment involved ten (10) fire fighters, five (5) police officers, thirty two (32) personnel from the army as well as other personnel form various organizations. Water was used to extinguish the blaze while fire breaks were utilized to prevent the flames from spreading to other area. The two techniques employed enabled the team to put the fire under control which led to complete extinguishing of the flames.

Impacts:

The biggest impact of the fire outbreak was the destruction of many of the unique palm in the world, Coco-de-mer. The palm is unique to the Seychelles because it is the only place where it grows in a natural habitat and very valuable to the tourist industry. Other species of plants like Latanier and Coco Plum were also destroyed. Other species of plants and small animals not accounted for also perished.

The fire was tackled at an early stage and this minimized the damage. Nevertheless a scare was visible after in the aftermath leaving the soil prone the erosion.

Lessons Learned:

The rapid intervention averted a catastrophe but still the following was the case;

- The lack of communication among crew leaders was evident.
- There was a lack of coordination between among groups of people involved.
- Better networking between/among organizations needs to be strengthened
- Distribution of food/drink and other supplies were not adequate
- Crew leaders need training to deal with such situations

Critical Assessment of the Technology Options Proposed in the National Communication

Key issues of stake holders

Removal of CO_2 capacity: Government (forestry division), forestry product consumers
The removal of CO_2 here deals mainly with minimizing the level of Carbon Dioxide in the atmosphere. The two major ways to achieve this are:

a. Reduce the burning of wood fuel
b. Increase the extent of forest for CO_2 absorption

As far as burning of wood e.g. for cooking is concerned this is not problematic here in Seychelles. This is because there are other alternatives like gas and electricity. For the increase of the size of the forest the key stakeholder will be government through the Ministry of Environment and Natural Resources (Forestry Division). This division will be the best one to coordinate such activities.

Another potential stakeholder will be farmers especially those specializing in agro-forestry. While they are expanding their farms they may as well reafforest areas with incentives from government.

Craftsmen/carpenters are important stakeholders since they use wood to manufacture various items including souvenirs and furniture. However, the Seychelles Forest Management Plan sector study revealed that the economic importance of the forestry sector is generally perceived as marginal. The sectoral GDP contribution, including wood industries is no more than 0.4% (1990). The employment effect of forestry activities is estimated at 350 people per year with about 820 carpenter (1987 Census) and 150 – 200 persons employed in the wood-working industry.

The private sector as well as NGO's will have to play a bigger role as stakeholders in technology transfer. Their role might not only by to operate the various technologies but to work in partnership with government to create the environment conducive to operate.

The people in general should be involved in decisions made since their livelihood can depend a lot on forest resources. Culturally forest products have influenced the way people have interacted e.g. using of wood for cooking and building. Forest in Seychelles has been used to portray its importance and forestry products in Seychelles has been one important factor that benefited the first settlers and given rise to the creation of the Seychelles nation. Therefore any technology transfer option needs to be carefully dealt with ensuring the survival of the cultural and historical heritage.

Critical local markets and needs

Markets:

With regards to local markets tourism industry can be looked upon as a market. This comes about through eco-tourism where the wild flora and fauna of the Seychelles attracts a lot of visitors. The economic benefit of eco-tourism is enormous for the country even though there are no monetary transactions between the forestry sector and the Ministry of Tourism.

The manufacturing industry is another area where forestry can play a major role. The bigger the forests the more raw materials will be available for e.g. handicrafts and light industries. In the case of Seychelles light industries such as handicraft does not have a very big impact on the forests simply because the scale of exploitation is very small. Thus this means very little impact on the natural forests and associated ecosystems.

Ministries and department are potential market in the sense that they rely on data and information for decision-making. The data needs to credible and accurate and this is where technology comes in. There is a variety of technologies which ranges from techniques and methods to software and databases. Geographic Information Systems (GIS) and Remote Sensing (RS) can be used to do that kind of job since this has been proven and also there is a Centre for GIS that can be used to implement RS.
Needs:

In the case of needs "*most small island states (including high islands such as Seychelles, Reunion, and Fiji), narrow coastal plains provide attractive locations for settlement and a variety of infrastructure to support economic and social needs. Most of the population, settlements, and economic activities are concentrated in areas where competition for space is acute and where fragile ecosystems, aquatic and terrestrial, coexist.*

As elsewhere, coastal development in most small islands has been undertaken in the past without taking climate change and sea-level projections into consideration. With currently projected rates of sea-level rise and flooding, coupled with the possibility of more intense and frequent extreme events such as cyclones (hurricanes) and associated storm surge, critical infrastructure such as social services, airports, port facilities, roads, coastal protection structures, tourism facilities, and vital utilities will be at severe risk. Furthermore, the capacity of most small island states to respond effectively to these threats is limited by their low adaptive capacity, which results from a combination of factors—including physical size (little opportunity to retreat), limited access to capital and technology, and a shortage of human resource skills." IPCC

The findings of IPCC illustrate that small islands states are very vulnerable to climatic changes and therefore their needs are greater.

A larger forest means scarcer land for other activities therefore one needs to identify ways to balance the two with minimal disturbances to the environment. The larger the forest the greater the threats and forest fire is one major factor that poses a threat to the natural habitat and technologies in alertness and preparedness has to be implemented and up to date. All personnel has to be trained further to face such an even should it occur. Fire prevention is of high priority because the immediate effect will be the CO_2 which will be released into the atmosphere while on the other hand there are other socio-economic impacts e.g. loss of property which follows.

Forests needs to be managed and;

Risk reduction strategies include:

- *vulnerability mapping;*
- *identification of areas that are safe for settlement and development;*
- *adoption of building codes based on disasterresilient engineering and on local hazard risk assessments; and*
- *enforcing these plans and codes by economic and other incentives.(GEO 3, 2002, page. 275)*

are important factors to be taken into account.

A GIS is a state-of-the-art technology which is being widely used globally. It comprises of software, hardware, data, methods/techniques and people and all these makes a successful GIS. *Linking location to information (or bringing the where to bear on the what) is a process that applies to many aspects of business and community decision making. Choosing a site, targeting a market, planning a distribution network, zoning a neighborhood, allocating resources, responding to emergencies—all these problems involve questions of geography* (Geography Matters, ESRI).
The Seychelles today possesses a national Centre for GIS which is based in the Ministry of Land Use and Habitat (MLUH). The Centre possesses a set of orthophotos of early 1998/99 and various sets of vector data. The Centre so far has been dealing mainly with vector data while the orthophoto serves as a background in map production at the same time providing a lot of details about an area and its surrounding. The Centre has already started however to produce better products with the datasets available but a couple of things need to be addressed.

Geographic information system (GIS) software gives you the power to answer these and many other questions quickly, accurately, and demonstrably by letting you see, explore, and analyze data by location. And that, in short, is what makes it such a valuable tool) (Geography Matters, ESRI).
With regards to land use GIS has been used to map areas and get information into attribute tables. When it comes to mapping forestry, very little information exists. The Centre for GIS has not yet ventured into mapping forestry but the advantages are already known. For instance RS will assist the Seychelles to;

- Identify the extent of vegetation cover
- Identify vegetation type
- Establish various vegetation classifications
- Monitor vegetation cover/change over time
- Create a vulnerability/hazard map

With this kind of information Seychelles will be able to;

- Have an inventory of vegetation type an their geographic location
- Monitor changes in LULUCF

- Make decisions based on the information obtained
- Quantitatively show the status of carbon stock in Seychelles and use the information for emission trading under the Clean Development Mechanism (CDM)

Seychelles however finds it difficult to adopt techniques in RS for the following reasons;

- Although there is certain of where the various species of vegetation are it is very difficult to identify species using the orthoimages (Remote Sensing (RS) seems to be the best option)
- RS techniques have not yet been applied in the country in order to detect plant species and to start using it would be an advantage e.g. in vegetation monitoring
- The Centre for GIS needs high resolution satellite images that can be used to apply learnt RS techniques
- The Centre needs to have the appropriate software that deals with RS
- Training for personnel in GIS but especially in RS is required

There is no doubt that GIS and RS would work in Seychelles because at the moment we have a GIS Centre that works. RS will work because there is the commitment and the people willing to learn. The main problem is funding. To have an RS Unit is Seychelles would not come cheap. Even though certain structure i.e. the Centre for GIS exists the data (images) as well as software will be costly. The Seychelles needs such a unit and the country needs to be assisted financially.

'The historic loss of forests is closely related to demographic expansion and the conversion of forest land to other uses". (GEO 3, 2002, page 91) Enforcing a clear Land Use Plan (LUP) demarcating each sector e.g. forestry will show where to build and where to preserve. The LUP will help allocate land to families and this will act as a mechanism to help prevent people from destroying their own habitat.

It is to be noted that government policy now in Seychelles encourages families to use gas instead of electricity or wood /charcoal for cooking. This in itself means there is a reduction of fossil fuel into the atmosphere and discourages people to use wood for fuel even though this practice is not very common these days.

Critical low-GHG technologies required to meet needs and demands

Low GHG technologies is extremely important to help meet needs and in the Seychelles context is most of all to use technologies in reducing the emission of CO_2 in the atmosphere. We have already identified that the burning if wood for fuel is low compared the other African countries but there are indirect implications that have to be looked at in order the further reduce emission.

One way which this can be done is to import appliances and equipment that consume less electricity and use no CFCs. The consumer will save on the electricity bill while less pressure will be applied on the power station, which in turn will emit less CO_2 since the oil is used to power the generators. In the case of CFCs this gas contributes to damage the ozone layer, increase global temperature and has an adverse effect on flora and fauna.

There is a need to build capacity to further enhance response in case of a forest fire. Alertness, preparedness, responsiveness and effectiveness are those major factors required to deal with a blaze. This will minimize damage and CO_2 emissions in large quantities.

An LUP will provide information while the extensive use of media and multimedia will provide the public at large another alternative to access information. Digital information such as Geographic Information Systems and Remote Sensing should be used to manage data and track changes overt time. Time-series information is very important because any change detected will indicate whether any situation is getting better or worse after appropriate analysis.

On the demand side the need for energy is growing. Indicators reflecting this are increase in population *(28 in 1771, 63,261 in 1980 and 84,623 in 2002 with a projected population of 102,000 in 2019). (Statistical Abstract (SA) 2001, p.7), Gross Domestic Product (GDP) at current prices from 2.5 billion Seychelles Rupees (SR) to 3.5 billion SR in 2000, (SA 2001,p.71).* The most important indicator is 'sales of electricity'. '*For Mahe and Praslin combined 90,090,000 kilowatts of electricity in 1991 and 170,018,000 in 2001 (SA 2002, p.93, table 70).* Individual workers and light industries have moved and still moving from manual tools to power tools while the public are moving from rivers to washing machine, from pestle and mortars to electric blenders and so on. The sophistication of the society has created more and more demands whereby more energy is required. Apart from low-energy appliances and fluorescent light bulbs educations is one of the best tools to deal with the demand. Consumers should be well informed about what they buy and its effect on the natural environment.

Evaluate findings with existing technologies

Seychelles possesses very good laws and policies (Environment Protection Act) on the environmental as a whole. Forest protection in the island also falls under those policies as well as regulations and "*Seychelles has the best preserved area of natural forest at the Morne Seychellois National Park". (Africa Environmental Outlook (AEO), 2002, p.145)* and "over 40% of the countries land area is under protection as nature reserves" (Habitat II, p3, December 1996). The country is already implementing new technologies to reduce emissions for example the use of LPG instead of kerosene and the seeking of permission from the Ministry of Environment and Natural Resources to burn. The legislations are 'automatic' protectors of forests; the environmental laws monitor development in forest areas thus minimizing threats.

The country is also trying to import ozone-friendly appliances to help reduce Chlorofluoro Carbons (CFCs) in the atmosphere. Imports also try and target energy-saving appliances like refrigerators for the same purpose as well as reducing pressure on the power plant as well as reducing consumer bills. Government needs to seek measures to eventually stop the importation of CFC appliances when appropriate and at the same time educate the population of its importance. Once the measures are in places strict regulations should be applied and ensure importers are abiding to the laws.

"As the shortage of coastal space becomes increasingly acute in many small islands, land reclamation often is practiced as a solution to this need. Ironically, this practice exposes these islands to greater risk by attracting more settlement and infrastructure to already highly vulnerable locations (IPCC). Reclamation has proved to be useful (Roche Caiman Housing Project) in moving people away from protected areas and forest and does not support the argument of the IPCC. Over 300 hectares of land has been reclaimed along the East coast of Mahe, over 20 hectares on Praslin and about 14 hectares at Anse Aux Pins. The uses of the reclaimed land will vary from catering for industrial estates to new housing schemes. In the case of Roche Caiman for instance all the necessary facilities are in place e.g. supermarkets that also sells gas stoves, a place a LPG can be purchased and so on. This ensures that the consumers in the area are at ease and would not find a necessity to destroy the forest or use heavy pollutants and the same will apply for the newly reclaimed land. However this internal migration will automatically mean more pressure will be applied on the reclamation area and the surrounding sea. The Seychelles government has in place many mechanisms to curb on the negative effects for example the Ministry of Environment and Natural Resources applying the Environment Protection Act and other policies, the Ministry of Industries and International Business regulating business development, the Ministry of Land Use and Habitat ensuring comprehensive and well planned social housing schemes and other bodies providing any kind of support and assistance.

In the case of fire, firebreaks have been a very useful and successful technology in preventing fire from reaching certain areas. For example on Praslin island there is a fire break which protects the Praslin national park which includes the Vallée-de-Mai, which is where the Coco-de-mer palms grows in its natural habitat, the only one of its kind worldwide. Institutional capacities (Seychelles National Report to the World Summit on Sustainable Development) do play an immense role in assisting reducing threats and impacts on forestry.

Identify gaps and weaknesses

IPCC remarked that *Developing countries lack the strong knowledge base, integrated physical infrastructure and diversified economy required to weather shocks and recombine existing resources in new ways to adjust to what has become a continuous process of change. They also lack the institutional mechanisms and capabilities to perceive opportunities and constraints, and to translate these into effective policies for change. The financing and skills needed to innovate, to adapt and to diversify are also*

exceedingly rare in these countries. Furthermore IPCC when on saying that *the limiting factors for technological transformation are not primarily technological but are instead part of the social, economic, political, and cultural milieus in which technologies are developed, diffused, and used. Market incentives, the structure of regulations, the content and quality of research and education, and social values and preferences all determine technological trajectories. (Heaton et al., 1991, p. 21).*

Forests need to be monitored using more advanced techniques like GIS and RS. This will ensure continuous monitoring the vegetation cover and how it is being affected over time. Furthermore data will be readily available for anyone who would like to conduct certain research regarding LULUCF in general.

"The introduction of the PAT in 1992 for the three main islands provide a broad and flexible zoning scheme indicating land use patterns bases on physical, economic, environmental and social conditions up to the year 2002" (Habitat II, 1996, p.17). The Plan d'Aménagement du Territoire (PAT) was too flexible *and "…has been criticized for not being a regulatory instrument for land use"* (Habitat II, 1996, p.17). However the PAT has shown that Seychelles' scarce resources need to be managed carefully and has presented ideas which people have adopted preventing irreversible catastrophes on the Seychelles environment. The result was that there has been a lot of encroachment. Since no comprehensive one exist at the moment the Planning Authority which involves other ministries like MOE controlling development in the Seychelles.

"The forest fires of the past five years in Australia, Brazil, Ethiopia, Indonesia, the eastern Mediterranean, Mexico and western United States have raised public awareness and concern about wildfires, catalysed national policy responses and mobilized regional and international initiatives for fire prevention, early warning, detection and suppression. (GEO 3, 2002, p.95). Canada acknowledged that Forest fires are a natural occurrence and necessary for the health of many forest ecosystems. Indeed, without fire, certain tree species and ecosystems of the boreal forest could not persist.(54) However, fires can also lead to massive forest and property damage; smoke and ash generated by fires can create health problems, both locally and at great distances.

Forest fires in the Seychelles as in any other parts of the world is still a threat and very difficult to predict or prevent any damage. The bonus however is that not all islands of the Seychelles possess the same vegetation type. For example dense forests grow abundantly on the granitic inner islands and together with human interference the forests are very vulnerable. On the coralline islands the vegetation thin with shrubs with less human interference. This makes those areas less vulnerable to fire and other human induced catastrophes. Measures can be adopted to reduce risk of fires for example in Canada's report on Climate Change Impacts and Adaptation it was highlighted that *many studies suggest that forest fires will increase in future due to climate change. To reduce fire-related losses in the forestry industry, Hirsch et al.(106) advocate the incorporation of 'fire-smart landscapes' into long-term forest management planning. Fire-smart landscapes use forest management activities, such as harvesting, regeneration and stand tending, to reduce the*

intensity and spread of wildfire, as well as fire impacts. The example planting species with low flammability was given as a measure to minimize destruction.

The East Coast Phase III reclamation and at Anse Aux Pins (Mahe) together with the one at Baie Ste Anne (Praslin) will move people from the main land but this will happen in the near future as opposed to an immediate effect. It is rather a long-term solution whereby for now the archipelago will still have to make use of the policies.

Appliances emitting less GHGs are not readily available on all international markets. Some markets may have the appliances but the cost to bring them into the country may be very high. So importers will tend to look for cheaper imports not realizing the consequences this may have on the environment.

The modern era present a certain obligation on consumers today, which has change the traditional ways people live. The urge to earn money in a short delay has caused individuals to procure equipment (e.g. the power tools), which can work faster and more accurate at the same time the power of the machines has caused a decrease in the labour force required. The solution is not straight forward because the prime argument will be the substitute for power tools, which are putting pressure on the power plant.

Biodiversity within forests is immense and "Seychelles has the highest level of amphibian endemism of any island in the world." (AEO, 2002, p.73). This also includes species living in mangrove swamps whereby "*Mangrove...line about 25 per cent of tropical coastlines. Mangrove forests are among the world's most biologically diverse and productive systems…provide food and refuge for many species and nutrients for the marine environment…nursery grounds for fish and shellfish…prime nesting and migratory sites for hundreds of bird species."* (GEO 3, 2002, p.93). The problem however is that "*Mangroves are threatened by activities such as overharvesting, freshwater diversion, pollution, prolonged flooding and fluctuating sea levels."* (GEO 3, 2002, p.93). The fact that biodiversity in Seychelles is characterized by high rates of endemism and relatively low species diversity due to its relative isolation from large land masses (Western Indian Ocean Environment Outlook, UNEP) means the forest itself does not have much influence on species diversity unless species are introduced. The Seychelles National Report to the World Summit on Sustainable Development illustrated that threats to biodiversity is by both direct and indirect human interferences. The problems as highlighted are lack of specific conservation strategies, threat from invasive species, forest fires, urbanization, existing terrestrial protected areas not designed to ensure efficient/optimal biodiversity conservation, poaching and cross-cutting needs for policy development including stakeholders and capacity building at all levels. The economic factor for all these issues has thus to be addressed.

Define actions required to implement critical technologies

Technology in the form of a method seems to be easier to deal with because it is mainly to deal with ideas as oppose to 'physical' technologies e.g. importing of solar panels. All

in all in whatever way the technology presents it should not be used as a deterrent but should looked at as a way to mitigate climate change.

The first action before implementing any form of technology is to see whether this technology is suitable for that country. This can be done by first assessing the countries needs as well as other factors like the geography of the country, which influence weather and climate. Also look at example in similar countries where the technology has been a success story.

In the case of the use of a methodology or a technique as opposed to a physical technology the same applies. We will need to assess their suitability in Seychelles and how it will fit within the existing policy framework and new policies yet to come.

A very important issue is 'who is going to implement the technology?' It is vital to identify at a very early stage whether government or the public sector is going to implement the project. Furthermore is type of business e.g. whether it is going to be a sole proprietor, partnership, private/public joint company etc. Implementers will have consider the economic theories e.g. short/long run costs, profit-making, changes in market forces and so on. In most cases the private sector focuses more on such issues.

Looking at the environment the main issue is the impact of such technology on the natural environment. Private costs (e.g. labour costs) and external costs (e.g. pollution) when added together give the social costs. Private benefits when added to external benefits give social benefits. Following this a proper cost-benefit analysis is needed before implementing the new technology. All financial implications should be in order before the technology transfer takes place. It is a matter of not only money to purchase the technology but also to make it sustainable.

Another vital question to be asked would be regarding the viability of the technology. Is it a technology that is here to stay or is it a technology that would phase out from its source i.e. the developer of the technology having to discard it after a few years leaving its users stranded? In many cases it is not very easy to predict the lifespan of a new technology both in technical terms and also how it will by a country's laws and regulations. This uncertainty may cast a lot of doubts among potential stakeholders and such technology good or bad may never get off the ground.

After a technology has been adopted there should be a period for trial and error. This technology has to be tested and the results assessed and various scenarios should be created to find the best options and use them as proof. This will determine whether the new technology may be used or not. There must be proof that the technology does work or does not work through results from evaluation and case studies.

The technology should go through certification processes and is validated prior utilization and distribution. One has to be very careful with certification and validation processes

because if these process are too complex it will create a barrier for that implementer. Certification and validation must be appropriate and implementers should not suffer from delaying tactics especially in the context of technology transfer between countries.

All technologies implemented should come with technical support or support available as and when required. The problem with no support or technical assistance is that the country will find itself in a situation where there is no upgrade, no spare parts, and new ideas innovation and so on jeopardizing sustainability.

When any technology is adopted training should go with it. Training should be provided by certified trainers with enough knowledge. Training should not focus solely on how to operate but also on maintenance of equipment where appropriate. Once training is over personnel will have to be conversant with it in order to ensure efficient usage.

It is very important to inform at least the people who will be involved with the technology before it is actually introduced. This will get them prepared in anticipation to the new ideas/systems.

Local knowledge should not be left aside. It is very vital to consult people with past experience or with institutional knowledge before introducing and implementing new technologies. After all one might discover that the technology is not required or only a modified version of it is necessary. Also the people who will benefit from it should have the opportunity to give their opinion.

Matrix

	Technology		Needs: Socio-Economic	Needs: Legal	Needs: Capacity
T	Prevention/action against forest fires		Finances/publicity[4]	More strict policies[2]	Training/Equipment[3]
E	Low power consumption refrigerators		Market research/more forex[3]	Policies on imports[1]	Ability to repair/upgrade[3]
C	Land Use Plan		Finances/awareness[3]	Laws for implementation[1]	Creation/update of LUP[1]
H	GIS		Finances[2]	Laws on data usage[1]	Training/Equipment[3]
N	Remote Sensing		Finances/Aid[3]	Policies on data usage[1]	Training/Software[3]
O	Products not using CFCs		Market research/finance[3]	Laws on imports[1]	Ability to repair/upgrade[2]
L	Added protection to water resources		Finance/awareness/livelihood[3]	More severe laws/law revision[1]	Training/personnel[1]
O	Solar water heaters		Finance/awareness[3]	Encourage its use[1]	Ability to repair/upgrade[1]
G	Information Distribution		Finance[3]	Encourage use of information[1]	Training/sustainability[1]
Y					

Colour code showing weight

Heavy[3-4]
Medium[2]
Light[1]

TECHNOLOGY	Technology		Combinations
T	Prevention/action against forest fires		9
E	Low power consumption refrigerators		7
C	Land Use Plan		5
H	GIS		6
N	Remote Sensing		7
O	Products not using CFCs		6
L	Added protection to water resources		5
O	Solar water heaters		5
G	Information Distribution		5
Y			

5 - less difficult to implement
9 - more difficult to implement

The matrix's role is to summarise the effective usage of the three combinations; socio-economic, legal and capacity against technology.

The colour codes depict the weight carried by each category. The dark colour indicates the category more difficult to achieve while the lighter colour depicts something easier to achieve. Furthermore in figure indicates again the wait which makes it easier to see which options are easy to implement and which ones are more difficult – 5 being easier to implement and 9 being more difficult to implement.

Key (a) partnership and (b) enabling environment to facilitate the tech-transfer

(a) Government is one of the major players to ensure enabling environment. Government can set up mechanisms through policies and regulations that will facilitate technology transfer. Government can also intervene financially e.g. providing concessions on taxes an introduce subsidies to the importer of the technology. It can also be a facilitator in negotiations/forum and consumer support as a whole.

The second key player will be the private sector. This private sector will be mainly the ones introducing the technologies rather than be the consumers themselves. On the other hand private firms however are also consumers since they may utilize the new technology to run their business or resell it to potential buyers. The private sector can play the role of the 'motor' while government can play the role of the facilitator.

The third key player will be the public, which is the bulk of the consumers. The consumers will be obviously the ones buying and at the same time the ones to give an indication whether the technology has good market or not.

(b) In order to facilitate technology transfer the enabling environment is very crucial for any transfer of technology to be successful. It is important that the technology to be transferred gets into the country fast and this will occur through tax concessions.

Now that the technology is in the country a place to run that business is vital since the business will need a place to operate. Incentives may be given but should be looked at together with the cost of production and the returns received on each unit of productions. Incentives are not to be used as a financial source but as an aid as and when necessary and also as a source of encouragement.
Laws and regulations should assist the project and not act as a barrier. Also there should be laws and policies to prevent competition coming from similar operators especially foreign ones.

The operator may require further concessions to import spare parts and technical support from abroad. It is important to pointed out that each project needs to be looked in a case by case basis depending on how much the technology is contributing to the Seychelles people and the economy as a whole.

Criteria for Effective Technology Transfer

GHG and Other Environmental Criteria

Reduction in GHGs and accountability tons of carbon meeting the required baseline is very important. This will ensure proof of mitigation of GHGs and the information will be utilized for further management of the forest and Carbon stock.

Accountability for percentage change in emissions of gases related to the GHG baseline will first of all provide the initial accountability process and tracking for year to year changes in emissions. The above will be the benchmark and driving force behind emission trading under the Clean Development Mechanism (CDM) as well as a tool for climate change related processes.

Policies for land use and forest management and protection of forest biodiversity ensure the survival of forests as well as flora and fauna. We have seen that the Seychelles do have good environmental policies, which means the country already has made that step forward.

Forest management and national parks has already enured that watersheds are protected ensuring natural water distribution by runoff, infiltration and so on. Still the biggest task is to prevent damages to the existing ecosystem and protect other water resources which are still vulnerable e.g. water diversion because of construction or destruction of the soil structure due to excavation. Another threat to forestry is plant diseases.

Diseases in forests affecting flora has been traditionally very minimal but in the past ten years there has been a dramatic increase in disease outbreaks on different tree species. According to the Forestry Division a fungus called *Vertcillium calophylli*, vectored by a beetle is responsible for wilting and death in Takamaka trees. In 1998, on Mahe the first disease attacking the Sangdragon tree was recorded. It was believed to be caused by a fungus called *Fusarium oxysporum* again vectored by a beetle. The cause of this disease is still under investigation. The Melittomma (*Melittomma insulare*) was first identified in 1904. Various methods have been employed to fight the disease but none proved to be effective. There are other outbreaks for instance a new outbreak was observed in the Mourouk (*Erythrina sp.*). Tests showed the species is being affected by a *Diptera* species known as Gall midge (*Cecidomyiidae*). This pest causes the swelling of the stem and leaves and eventually the tree die. Other new diseases have emerged or are emerging and the moment any new diseases are detected the cases are investigated to find the cause and

the way to contain and fight those diseases. Where a disease can be controlled appropriate measures are taken but when applied measures are not effective or where a disease a unknown then measures to contain the strain is applied i.e. isolation of areas, educating people on how not to propagate the diseases.

When it comes to fighting tree diseases it has been found that;

- There are not enough local experts to deal with the problems
- Not enough specialized personnel trained in specific fields
- Laboratories for investigation and control is not up to the standard
- Quarantine is partly successful in protecting our existing species

The consequences of diseases on our flora as follows;

- Loss of economic timber e.g. Sandragon or food resources e.g. coconut
- Loss of biodiversity
- Change in scenery and landscape
- Increase in erosion both inland and along the coastal area increased in erosion in water catchments
- Decrease in carbon stock which is essential for emission trading

The main question however is whether those diseases are really a threat to forests in the Seychelles and obviously the destruction of forest by pests will have an impact on the biomass and carbon stock.

Agriculture also plays a role as a contributor to the biomass and carbon cycle in Seychelles. In the case of Seychelles and Madagascar unsuitable topography however for agriculture is a limiting factor particularly (Western Indian Ocean Environmental Outlook, UNEP). This means that the contribution will not be on a large scale.

Economic & Social Criteria

In the economic and social context the average & marginal costs should be estimated and compared to alternative options. Other than the price of imports prices of other factors of production e.g. labour can influence the price of a final product, in this case a technology.

If the average costs and the extra cost for producing one extra unit are too high then other ways to run the same technology at a lower cost needs to be sought Therefore cost/benefit analysis should be performed and benefits should always exceed to costs for the sustainability of the implementation of the technology. The transferor of the technology at this instance should not be aiming at maximizing profit because profit maximization does guarantee an affordable price but the contrary.

Sellers of the technology should have the confidence that the return they receive exceeds the cost of production and their technology is sheltered from piracy. This will encourage other sellers to bring in other technologies required to reduce CO_2 in the atmosphere directly or indirectly.

Opportunity cost is a very important element to be looked at when it comes to the purchasing and implementation of new technologies. The fundamental question is; 'what do I sacrifice if I use the technology?' Are the sacrifices monetary, socio-economic, cultural or moral?' All these have to be balanced out and taken in account.

Macroeconomic consideration e.g. (Gross Domestic Product) GDP trends, employment versus unemployment, inflations, interest rates terms of trade, injections and withdrawals in the economy all have to be considered. These will give an indication about the health of the economy and from this one will be able to derive whether investment/implementation of new technologies is feasible both in the short term and long term alike.

Income groups and consumption pattern is important since the success of it depends a lot on consumption. No one is going to invest in providing new technology where there is nobody to consume. It is vital therefore to know how consumers spend their money.

Administrative, Institutional and Political Criteria

Knowledge about the technologies should be at hand and the technologies should be developed in such a way that it is easy to use and appreciated by the users/consumers. A difficult technology will not attract consumers and not be easy to run and maintain since there will be high cost involved in training and operations.

Some technologies may be available but sometimes they are too difficult to reach. It is not only about market locations but in order to run the technology the other parts and accessories have to be bought separately and sometimes those parts are not available. Buyers must have access to the technology. Patent and licenses are two other factors that reduce access to technology and restrict its propagation and use.

Administering of a technology especially a new one is very important. Institutional capacities have to be in place to undertake necessary information collection. This is to

ensure good knowledge about the technology and subsequently its operation and effectiveness to do the job required.

Political considerations have to highlighted because too often many bureaucratic processes often discourages those who would wish to move towards. It is No one will venture into introducing any new technology in country with conflicts and violence. The technology also needs to be adaptable in various socio-economic and cultural settings and platforms.

Process-related Criteria

Market penetration is vital the Seychelles will need to know the geographic extent of penetration and impact on existing technologies. From this one will be able to derive the level usage and whether there are any conflicts between/among technologies already operating in the same environment.

Long-term institutional capacity should cater for flexibility and capacity to adapt to changing circumstances and to re-sell to both original provider and other potential purchasers with improvements. There should be capacity for local staffing as well as long-term financing. Training and management practices have to be improved every now and then to keep up with growing expectations.

Once a particular technology has been adopted there has to be continuous monitoring and evaluation to ensure a sustainable service delivery.

- The delivery of service provided by the technology has to be continuous and serving targeted users.
- There needs to be a comparison between actual and intended benefits. This is true since in certain cases the benefits anticipated are not what the actual benefits are. In such circumstances the delivery will be affected.
- The technology needs to perform to satisfy expectations. Sometimes it is very difficult for it to deliver without other external factors e.g. the enabling environment. Therefore one has to look into the possibility that does not rely heavily on other externalities.
- The quality of benefits has to be measured. This will make it easier when it comes to upgrading the technology and also advise other local users/countries should they adopt the same technology.
- All beneficiaries from creators to users of the technology need to be satisfied. This will boost confidence and all parties will be willing to invest/utilize more of the technology.
- Benefits from the technology need to be distributed across the board. Equity may not necessarily be financial. All players can benefit from a better living condition

e.g. by spending less on electricity, training for distributors of the technology and so forth.

- Maintenance of a technology is very important because this will ensure its day-to-day operation and keep it at a sustainable level. New ways and updates have to be followed up to reduce maintenance cost while one should not ignore preventive measures that would minimize breakdowns and/or operation difficulties.
- The economics of applying a new technology in the Land Use, Land Use Change and Forest Sector as well as any other sectors is one of the most important element and a decisive factor which will determine whether a new technology will be adapted or not. It all comes down to money. Other than the fact that in most cases a new technology has to be purchased other financial implications have to be addressed.

  Government is a non profit-maximising body and therefore will not tend to make a profit should it decides to introduce and sustain a new technology. If the technology is for the general benefit of the Seychelles then it will tend to subsidies to cover the difference between the average total cost and the average total revenue.

  On the case of the private sector a body introducing and implementing a project will tend to maximize profit where marginal cost equals marginal revenue. Thus consumers might bear the costs and the project might not necessarily work or be accepted. However government can assist the private sector e.g. reducing import tariffs as we have seen previously and this should help pull down the costs.

A stakeholder Typology

Sources and developers of technology

This includes individual and groups (organization), which originally develop the technology with proof of ownership where applicable. Typical developers would include scientific research organization, Research and Developments within private firms as well as government bodies. Technology can be developed in either public or private sector.

Owners and suppliers of technology

The owners and suppliers include private firms, state-owned enterprise and government agencies. Technologies are normally forwarded to the private sector from government because the former may be better equipped to tap the market to its fullest.

Buyers of the technology

Buyers are the primary stakeholders in the process. Buyers are usually private firms but can include state owned enterprise. Not all developers of technology are willing to sell their ideas and/or product. Many of them will be leasing them with the idea to still have a hold on their work. Other developers will keep control of their technology but give rights to other firms to redistribute as retailers over a certain period while not allowing any party whatsoever to copy or modify their work. These kinds of partnerships are usually binded with agreement regulations.

Financiers of technology transfer

Financiers are the ones who lend money to buyers to purchase the technology from suppliers. These are institutions like commercial banks, international financial institutions and individuals. Agreements are usually established within the parties involved on e.g. how to repay.

Information providers

Information providers are bodies such as United Nations agencies that have no commercial interest in the process whose objective is to facilitate matchmaking between the buyers needs and what suppliers have got to offer by providing unbiased information. This information could include technology options/types, sources, data and data processing information, case studies of where the technology have worked or failed so that countries can decide on their respective approaches. Finally the information network would also include methods for evaluating different options.

Market intermediaries

This includes consultants, Non Governmental Organisations (NGOs) media, consumer groups and trade associations. Market intermediaries are those that can have a direct or an indirect influence on the buyers' decision by providing more concentrated information about technologies. This is so because these bodies are constantly tracking updates/changes and this may be reported as news in various formats. Intermediaries may promote certain technologies at the expense of others but the main goal is to run activities that should benefit everybody.

Governments

The government of the purchaser's technology sets the parameters for transactions. This can be through laws and regulations, incentives and financial support through the financial mechanism and monetary policy and provide frameworks and guidelines governing imports of the technology. Governments may balance out social costs and social benefits i.e. cost and benefit to society (e.g. smoke hazard causing pulmonary

problems). Where the social costs are too high governments may consider other options and may not adopt the technology.

Governments may set up partnerships among countries providing the technology and receiving countries alike. This will ensure ease of transfer in support of the climate stabilization.

Conclusion

This paper analyses the different ways to achieve technology and a country should identify in which sector the transfer is to take place. The first lesson that can be drawn is no country should launch into technology transfer without first having a thorough look at the situation. There are various implications in the case of technology transfer in the Land Use, Land Use Change and Forestry sector. One has to look at whether the transfer is possible, certification and standards, its availability, who should implement it, where to implement it and the cost and benefits of such activity. Finance is a very important factor in technology transfer. Financial implications is very crucial because first of all funds is necessary for the initial setup and secondly funds generated by the implementation of the technology needs to be carefully managed while in can later be injected back into this new technology transfer. It is very important to see what other similar countries are doing and rate their success. This should give an indication whether a technology would work and under what circumstances.

Technology has to be balanced with people's interaction with their surrounding environment. The effects of new technology in a community may or may not improve a community's livelihood. It is very essential that the community is consulted and they can relate themselves to the technology transfer in question. This will ensure willing participation at various levels.

Finally in order to successfully implement technology transfer policies must be in place. Those policies will serve as laws and guidelines to facilitate interactions among stakeholders. Successes in technology transfer will depend a lot on policies ensuring the elimination of certain barriers, equity, access to resources, consultation among stakeholder, consultation between implementers and the community and a technology for the benefit of everyone.

Bibliography/ References

Environment Management Plan of Seychelles (EMPS) 2000-2010

The Seychelles National Communication under the United Nations Framework Convention on Climate Change

Town and Country Act – Ministry of Land Use and Habitat

Forest fire report checklist – Ministry of Environment

Seychelles Forest Management Plan/Sector Study, October 2003, INDUFOR Oy

Statistical Abstract, 2001, 2002 Edition, Management & Information Systems Division

Africa Environmental Outlook – Past, present and future perspectives, 2002, United Nations Environment Programme (UNEP)

Habitat II – National Report and Plan of Action for Sustainable Settlements Developments 1996 – 2000, February 1996

Forest Disease Report – Diseases of Sangdragon Trees

Exploring Corporate Strategies, Fourth Edition, 1997, Gerry Johnson and Kevan Scholes

Economics Explained, Revised Third Edition, 2000 - Peter Mauder, Danny Myers, Nancy Wall and Roger Leroy Miller

Climate Change
Impacts and Adaptation: A Canadian Perspective, FORESTRY

Climate Change 2001; IPCC Third Assessment Report

Special reports on Emissions Scenarios, Regional Impacts of Climate Change, Land Use, Land Use Change and Forestry, Methodological and Technological Issues in Technology Transfer and Aviation and the Global Atmosphere

Global Environment Outlook 3, 2002, United Nations Environment Programme (UNEP)

Global Environment Outlook 2000, 1999, United Nations Environment Programme (UNEP)

Geography Matters, ESRI

Modeling our World – The ESRI Guide to Geodatabase Design, 1999 ESRI, Michael Zeiler,

ILWIS 3.0 Academic – User Guide – INTERNATIONAL INSTITUTE FOR AEROSPACE SURVEY AND EARTH SCIENCES (ITC), May 2001

The ESRI Guide to GIS Analysis – Volume 1: Geographic Patterns and Relationships, 1999 ESRI, Andy Mitchell

Western Indian Ocean Environment Outlook, 1999, UNEP

Seychelles National Report to the World Summit on Sustainable Development, 2002, Ministry of Environment, .Government of Seychelles.

4. Assessment of Technology Transfer in the Health Sector

Lead Author: Danny Poiret

Introduction

Climate change will have wide ranging consequences on human health and well being through a variety of mechanisms. Long term changes may affect many requisites of good health - sufficient food, safe potable water, secure community settlement and family shelter and the environmental and social control of various infectious diseases.[5,7] Technological actions taken to reduce the emission of greenhouse gas or the health impact of the climate change can themselves affect population health[5]. The protection and improvement of population health must be recognized as a central goal of development and for securing technology transfer. Therefore, the evaluation and full-cost accounting of technologies introduced to mitigate climate change must include an assessment of the impact of those technologies on health[5].

It has been reported that the effective global response to climate change would require the development and transfer of environmentally sound technologies between and within countries, for adapting to climate change and for mitigating the effects of greenhouse gas emissions. It has also been recognized that a number of social, economic, legal, political and technology factors may influence the flow and quality of technology transfer, whilst technology that meets the local needs and priorities are more likely to be successful[5]. Hence the elements of successful transfer will result from the removal of barriers, understanding and the active participation of all partners.

"Technology transfer" is defined by the IPCC as the broad set of processes covering the exchange of knowledge, experience and equipment amongst different stakeholders such as government, private sectors entities, non-governmental organizations, financial institutions and research institutions, that lead to the development and the dispersal of technology for adapting or mitigating to climate change. The broad and inclusive term "transfer" encompasses both diffusion of technologies and cooperation in the field of technology, across and within countries. It consists of the learning process, utilization and duplication of the technology to adapt to local conditions.

Within the last fifty years, the world has witnessed progress in health technology that exceeds those of all the preceding centuries. It has been acknowledged that in many societies technological innovation has enhanced life expectancy and access to care and health status. The term "health technology" includes the techniques, drugs devices and other equipment and procedures used by health care professionals in delivering medical care to individuals and the systems within which such care is delivered [1].

Case Study 1: Medical Plants vs. Pharmaceuticals for Tropical Rural Health Care.

Thomas J. Carlson, Department of Intergrative Biology, University of California.[5]

Keywords: Medicinal plants, pharmaceuticals, biodiversity, ethnolinguistic diversity, tropical countries, USA, Europe.

Summary

Tropical rural communities may receive treatment from locally available traditional botanical medicines and/or modern pharmaceuticals. Assessment of these two medical systems generates interesting comparisons when evaluating local indigenous versus external control, access, availability, affordability, long term sustainability and ability to safely and effectively use each medical system. Each medical system maintains a characteristic capital flow between North and South and rural and urban. Traditional botanical medicine is based on local indigenous resources and knowledge. Climate change and ecosystem damage diminish the local biological resources available to tropical rural communities to contribute to their health care needs.

Background

While pharmaceutical companies conduct advertising campaigns in tropical countries to increase consumption of pharmaceuticals in urban areas, most people living in rural areas have limited access to or cannot afford these drugs. The World Health Organization estimated that 80% of people in the world use medicinal plants as their primary health care medicines. Research on the bioactivity of the tropical medicinal plants has demonstrated that most are safe and effective therapies. Unfortunately, tropical public health programmes do not usually recognize the therapeutic value of traditional medicine and instead encourage widespread use of pharmaceuticals to treat diseases already adequately managed by locally available traditional botanical medicines.

Due to the research, development, formulation, packaging, distribution and refrigeration costs, pharmaceuticals are capital and energy intensive form of medicine that are under external urban and/or Northern control resulting in capital flow from rural to urban and South to North. These capital and energy inputs make the cost of pharmaceuticals high and reduce access for tropical rural communities. If pharmaceuticals reach these communities there is often not a continuous supply or available refrigeration. If refrigeration is available it requires a high capital input and energy consumption. Many donated pharmaceuticals have exceeded their expiration date and are often for ailments that are rare or not present in the recipient communities. When pharmaceutical are used by rural populations, they are often given inappropriately (wrong dose and/or for wrong disease) because modern medical professionals are seldom present to correctly administer these medicines.

Approach.

Locally available medicinal plants can contribute to health care needs and generate economic benefits for tropical rural communities. The World Health Organization Traditional Medicine Programme and other research programmes have conducted research on tropical medicinal plants that have demonstrated safety and efficacy for the treatment of common tropical diseases including malaria and infection of the skin, lungs and gastrointestinal tract.

Collaborative agreements may be established that enable tropical rural communities to harvest botanical medicines from their local ecosystems and sell them to northern or tropical urban areas as herbal medicine or for the extraction of pharmaceuticals. Twenty five percent of modern medical drug prescriptions written in the United States are pharmaceuticals derived from plant

species. In compliance with the Convention on Biological Diversity, these collaborative relationships between rural communities and research institutions can include agreements that will entitle communities to receive long term benefits if marketable pharmaceuticals or herbal medicines are derived from their botanical resources.

Impacts

Tropical rural traditional medicines under local indigenous control are more affordable, available, and sustainable forms of medicine, because they do not require the capital and energy inputs needed for pharmaceuticals. These botanical medicines are typically more therapeutic and safe because the medicine source is locally harvested and the local ethnolinguistic group knows knowledge of its medicinal use. Use of ethno botanical knowledge can also generate economic benefits that result in capital flow from urban to rural and North to South enabling local communities to use these resources to establish land demarcation, community –base medicinal plant reserves, traditional medicine hospitals, infrastructure support for a traditional healer s' union, supplies for schools, and clean water systems. These health care and economic benefits derived from ethnobotanical knowledge generate incentive for tropical rural communities to conserve their biological and ethnolinguistic diversity.

Lessons Learned

Table 2. Tropical Botanical Medicines Versus Pharmaceuticals

	BOTANICAL MEDICINES	**PHARMACEUTICALS**
Indigenous Control	↑↑↑↑↑↑	
External Control	↑	↑↑↑↑↑↑
Indigenous access/availability	↑↑↑↑↑↑	↑
Long-term sustainability for indigenous community	↑↑↑↑↑↑	↑
Ability of indigenous community to use medicine appropriately	↑↑↑↑↑↑	↑
Cost of medicine	↑	↑↑↑↑↑↑
Commodity produced and sold by indigenous community	↑↑↑↑↑↑	
Capital flow South to North		↑↑↑↑↑
Capital flow North to South	↑↑↑↑↑↑	
Capital flow rural to urban		↑↑↑↑↑
Capital flow urban to rural	↑↑↑↑↑↑	

First, as demonstrated in Table 2, many barriers exist to safe, effective, affordable and sustainable use of modern medicines in tropical rural communities. Tropical botanical medicines under local rural indigenous control are more affordable, available, therapeutically beneficial and sustainable for these communities.

Second, modern medical health care programmes should work to complement rather than replace the local traditional botanical medical systems. The use of modern pharmaceuticals at the local rural level should be reversed to only treat those diseases not well managed by the local botanical medicines. When pharmaceuticals are used for specific ailments, there should be careful monitoring of the treatment by modern medical professionals to make sure the correct dose is given and the appropriate disease is being treated.

Third the local traditional medical system should be included as integral components of tropical health care programmes.

Fourth, use of ethnobotanical knowledge and harvesting of non-timber medicinal plant products from their local ecosystems can generate economic benefits for rural communities.

Fifth, the health and economic benefits of botanical medicines can establish incentives for rural tropical people to conserve their ecosystems, ethnobotanical knowledge, and languages.

Sixth, and perhaps most relevant to the climate change issue, all of these efforts to encourage the use of indigenous, ethnobotanical and local resources can help to preserve these areas and there-by contribute to the mitigation of climate change.

Case Study 2: Malaria Prevention in Seychelles Island.

Keywords: Seychelles, Anopheles mosquitoes, Parasites, Plasmodium falciparum, Plasmodium ovale, Plasmodium vivax, Plasmodium malariae, Malaria, Chloroquine, disinsecting, aerosol dispenser, Healthy population.

Summary
Since the opening of the International Airport the country embarked on a programme of preventing the entry of malaria vector into the country. The Ministry of Health has successfully implemented the policy and enforced the International Health Regulations, which help to protect the population's health while accelerating the social and economic development. Nevertheless to maintain the health of the population requires the un-impairment of the natural system. The global climate change could have could have an impact on the human health through indirect pathways, changes in the vector propagation and diseases. The replication of such programme can be implemented by other small island state.

Background

Malaria is undoubtedly the greatest threat to human health. This potentially fatal disease is spread through the bites of infective female Anopheles mosquitoes, which transmits a parasite (Plasmodium falciparum, Plasmodium ovale, Plasmodium vivax, Plasmodium malariae) between infected people. The disease is prevalent in the developing world and is one of the leading causes of morbidity and mortality. Forty per cent of the world's population (two billion people) is at risk of malaria. Global estimates of the disease burden reported 300 to 500 million clinical malaria cases occurred annually, of which 90% are on the African continent. There are nine hundred thousand deaths per year in Africa mainly in children less than five years of age and pregnant women.

Flu like symptoms, including chills, fever, sweats and headaches characterize the onset of malaria. Mild cases are easily treated with quinine and doxycyline, while complicated cases

require hospitalization. P. falciparum is resistant to chloroquine and is becoming resistant to sulfadoxine-pyrimethamine, and other drugs**.** Malaria disease is associated with considerable economic burden, including cost to government and patients, for hospitalisation, consultation, promotive services, control programmes, drugs, loss of man-hour and loss of manpower through diseases, death and impaired education of children due to absenteeism. The economic cost of malaria to the Seychelles neighbouring countries has been estimated at approximately US $17000 million per year. Although Seychelles is free of the disease, it must be emphasized that the island has ideal (tropical) condition for the propagation of the vector. In March 1908 following the disembarkation of a group of labourers from Madagascar on to Aldabra island 91 cases of malarial diseases were reported, and this was the first recorded outbreak of malaria, which had occurred in any of the Seychelles group of islands. No Anopheles vector was found nor its eggs or larvae by Dr. Power, the Assistant Medical Officer and Mr. Fryer a member of a Scientific Expedition Group. As it was not clear to the Assistant Medical Officer of Health at the time how the infection spread, anopheles mosquitoes not being in existence on Aldabra, I would tend to speculate that the infection took place during the transportation period on board the ship where the vector would have been present. The second reported incident was in 1930 on the island of Assumption and again it was all imported cases. To date we are still recording on the average nine (9) imported cases per year among expatriate workers and non – immune local citizen travelling to endemic area without taking the necessary protection, table 3. Such events highlighted the importance of surveillance and control, which the authority enforced.

Table 3. Number of Reported Cases of Malaria from 1987 – 2001

YEAR	No. OF CASES
1987	**2**
1988	**3**
1989	**6**
1990	**7**
1991	**6**
1992	**3**
1993	**5**
1994	**12**
1995	**18**
1996	**15**
1997	**8**
1998	**6**
1999	**21**
2000	**8**
2001	**11**

Source: Epidemiology and Statistic Section Ministry of Health.

Nevertheless the effect of climate change could have various effect on the human health, propagation of insect / pest and diseases. Many of the effects / impacts could manifest itself via a devious, delayed effects of interferences to the natural system and the ecological interaction. Unfortunately the change may alter the abundance distribution of mosquitoes and the introduction of new mosquito species as the island lies within the tropical region.

Approach

With the improvement in the travelling industry and the opening of the Seychelles International Airport in 1972 there was a considerable increase in the number of flights landing on the island. The dramatic increase in the speed of aircraft with tremendous development of international air traffic has brought about a higher risk of conveying insect vector of diseases from one country to another. (Examples are the so called 'Airport Malaria" transmitted by infected Anopheles introduced by aircraft in non-endemic areas Paris, Amsterdam, Geneva, London in the recent years) Hence, it was of paramount importance for the Seychelles government to ensure that no new vector of diseases is introduced into the country so as to protect the population. The Ministry of Health was mandated to enforce the Quarantine Act Chapter 197 (Subsidiary Legislation) 1991 and the International Health Regulation.

Any aircraft arriving in Seychelles lands on/at the authorised aerodrome (Seychelles International Airport) and if it comes from a malaria infected area it is disinsected[2] prior to landing or on the ground by using the World Health Organisation approved one shot aerosol dispensers at the rate of 10 grams aerosol per 1000 ($28.3m^3$) cubic feet of airspace. The Port Health officer ensures that such procedures / requirements are adhere to before the disembarkation of passengers and cargo.

Impacts

The implementation of such programme over the years has led to the maintenance of healthy Seychellois nationals free of malaria vector and diseases and they can contribute actively towards the economic growth of the country. The spinoff is that the government is not required to spend: On treating malaria cases, which costs on average $2,700 per case;

- To implement intensive control programme which involves the purchase / importation of chemicals for residual spraying and impregnation of bed nets;
- To import and provide bed nets;
- To provide chemoprophylaxis for children and pregnant women;
- To provide Malaria medical treatment for the population.

And the families are not suffering for the loss of their loved ones or incomes, through deaths caused by complicated malaria cases.

Lessons Learned

Prevention of malaria has significantly permitted the progressive socio economic development to proceed with the active participation of the Seychellois population. The basic programme evaluation obstacle is determining to the full extent what would have happened had the policy makers and the Ministry of Health closed their eyes to such preventive approach and the programme never existed? Nevertheless we still have to be conscious that changes in the geographical range and propagation of vectors due to climate change could require the readjustment of the programme.

[2] Approved disinsecting procedures are of three types: AAA Disinsecting before takeoff or "Block Away", BBB Disinsecting on the ground on arrival and CCC Residual Treatment of aircraft.

The sustenance / maintenance of the programme is important for the benefit of the country and the population at large which can be easily replicated in other small island states.

Case Study 3: Rodent Control to Protect Public Health and Reduce Economic Losses.

Keywords: Rodents, Rattus Rattus, Rattus Norvegicus, Mus Musculus, Leptospirosis, Rodenticides, Klerat wax blocks/pellets.

Summary

The three main rodent species are in abundant in Seychelles causing damage to property and exposing the population to risk of contracting leptospirosis. Rattus Norvegicus is more prevalence hence the increase in the number of leptospirosis reported cases over the years. Cost related to treatment of rat-borne diseases, damage caused to food and other items has been estimated in excess of ten million Seychelles rupees per year, while the control programme initiated by the Ministry of Health (Environmental Health Section) sponsored by UNDP / WHO failed to produced the desired result.

Background

In the absence of research, speculation developed into elaborate belief that the Seychelles islands were naturally free of rodents until the arrival of man. The introduction of rats by ships on the islands during the transportation of slaves, inhabitants and cargo in the seventeenth century has caused the extended nation to cohabit with them. Today all three main commensal rodent species (Rattus Rattus, Rattus Norvegicus and Mus Musculus) are present in large colonies, roaming the island and affecting the population, through the spread of diseases or damages caused to property.

The distribution and densities of Rattus Norvegicus and Rattus Rattus present a very serious risk of disease transmission. All evidence suggests that over the last decade the rodent problem, particularly Rattus Norvegicus has increased in line with the systematic increase in Leptospirosis cases. Among the tropical countries, Seychelles can be considered to have one of the highest incidences of Leptospirosis (100 per 100,000) with a mortality rate as high as 10%. This state of affair has been attributed, to the rapid development, deforestation, mechanization, construction, industrialization together with poor solid waste management, and decreasing standard of environmental hygiene thus providing rodents with the perfect marginal habitat.

Table 4. Number of Notified Cases of Leptospirosis 1987 - 2001.

No. of Cases per Year

Disease	**'87**	**'88**	**'89**	**'90**	**'91**	**'92**	**'93**	**'94**	**'95**	**'96**	**'97**	**'98**	**'98**	**'00**	**'01**
Leptospirosis	47	38	34	61	60	17	26	23	58	55	51	36	21	24	70
Death (Fron 1995 – 2001)									**6**	**2**	**6**	**3**	**6**	**3**	**7**

Source: Epidemiology &Statistic Unit.. Ministry of Health.

Cost related to rodent damages in the country is notoriously difficult to compile as it involves several different sectors. In 1994 the Cable and Wireless reported an estimated annual loss of two million Seychelles rupees, while the farmers and shopkeepers estimates were between three thousand to ten thousand rupees per year. The undetermined costs of rodent borne diseases such as leptospirosis and the debilitation, loss of man-hours and associated medical expenses, damage to stored food and homes should significantly raise the total financial cost in excess of ten million rupees per year.

Approach:
The density of rodent is considered to be too high in the country, hence an aggressive vector control programme was undertaken by the Ministry of Health (Environmental Health Section) in 1994 sponsored by the United Nation Development Plan (UNDP) / World Health Organization (WHO). During the intensive campaign the Environmental Health Section was responsible for conducting surveys, treatments and the indoctrination of the nation on factors contributing to the high density and their role in transmission of diseases, damages caused and ways and means of controlling them.

Through surveys of infested places and treatment with rodenticides used in different formulations (Klerat wax blocks and pellets containing 0.005% w/w brodifacoum and the human taste deterrent denatonium benzoate), house to house inspections to encourage environmental hygiene improvements and the application of the Public Health Act were necessary, radio and television programmes aired to increase public awareness. Leaflets and posters were printed and distributed to the Public, Health Centres, Schools and other working establishments. Infected patients interviewed to assess the possible route of infection and subsequently treatment administered to their respective premises.

Impacts:
- During the year that the programme was running, there was a drop in the reported number of cases of leptospirosis.
- Most of the productive establishments took their responsibilities in securing their premises against invasion by rodents.
- The population became aware of the problem associated with rodents.
- There was marked improvement in the refuse collection and disposal system. More bins were made available to the public.

Lessons Learned:
Rodents have been a major public health, agricultural and economic hazard and a cause for concern since pre-independence time. The colonial government introduced a bounty on the rat-tails at one time so as to reduce the rodent population as well as to prevent the introduction of diseases. Such moves did not solve the problems. The Ministry of Health initiative for controlling rodents in the country was a good one but, such should have been addressed with a wider scope involving all Ministries, all social partners and the population should have been more committed towards the success of the programme. Today we are noticing an increase in the number of leptospirosis cases and deaths, while the population has completely overlooked their guards and responsibilities.
It is quite obvious that, without the active participation and clear understanding of the community, our efforts to control pests of public health importance will be a futile exercise. As we comprehend that there will be no lasting change without health awareness and understanding

the liaison between pests and diseases, and the economic losses. Although, experience from other countries tend to suggest that chemical control of rodents alone will never bring down the density; it is only by eliminating the conditions encouraging breeding that a measure of success can be achieved. Our people must understand those conditions and appreciate that in majority of cases they are responsible through their own doings, either through their act or omissions. The socio - economic factor and health implications resulting from this state of affair must also be impressed on them. People must acknowledge the fact that better hygiene and sanitation will lead to good health through an excellent living condition. The way forward is to turn the rodent control programme into a national campaign.

Table 1: Policy Context Analysis

Dimensions of Enabling Environment	Policy Dimension	Applicable Policies Currently in Place	Effectiveness of these Policies	Gaps in those P
National system of innovation.	Centre for Health Studies. Mission Statement The Centre for Health Studies promotes excellence in health care and professional practice through provision of high quality education and training opportunities and programmes.	Not available.	Not applicable.	Not applicable.
Social Infrastructure and Participatory Approaches	(Non – governmental organisations, Social movement and community organisation.)	Not available.	Not applicable.	Not applicable.

Human and Institutional Capacities.	As it is well known in the country there is a dearth of sufficient numbers and quality of trained personnel to cater for the country's general manpower requirement. At national level the Human and Institutional Capacity Building Plan together with the Sectoral Studies recommendations should be implemented. Nevertheless the Ministry of Health have it's own plan which addresses the training needs of the Department / Section. It is stipulated in the training policy that the Ministry of Health undertakes to ensure: • That all new recruits to the Ministry will receive appropriate "off the job" induction training. This will be followed by supervised "on the job" instruction as part of an on going programme of training to develop all employees and to satisfy the Ministry's objectives. • That promotion of staff will take place after suitable training beforehand or immediately following the job change • That all staff have the opportunity to attend training courses, either locally or overseas to enable them full job satisfaction and career development • That the performance of staff is regularly reviewed with time allowed to fulfill the needs of the individual and the Ministry. The Environmental Management	National Manpower Policy 1998. Training Policy Manpower Development Board – replaced by Social and Human Resource Committee (SHRC) (NVTB - National Vocational Training Board) The Ministry of Health Training Policy is still in its infancy and is yet to be put into application.	Outdated. Not effective for the present time / development. Needs to be updated or re-drafted. Being implemented partially by the Ministries concerned.	Numerous gaps in t as it was drawn one party state per does not suites th development stra scenarios of the cou

	Plan of Seychelles 2000 – 2010, makes provision for strengthening capacities to better participate in projects and programmes related to Health, the Environment and Development.			
Macroeconomic Policy Frameworks.	Seychelles economy is dependant on tourism fisheries and light industry. It has gone through rapid socio economic development, which has resulted in improved social standard with a per capita (GNP) gross national product of US$ 6000. The economic success over the years has permitted the government to invest heavily on health development and to strengthen its policies on the population's health amounting to US$ 300 (Health Expenditure) per capita. Over the years the Health budget have systematically increased to cater for the service, demand and development. This resulted in the government being able to maintain a healthy population status and the island free from the major infectious diseases affecting the neighbouring countries. With the rise in life expectancy and the changing life style of the Seychellois nation the disease pattern has significantly change with higher incidence of more chronic diseases affecting the population. Management of these diseases are more expensive and requires advanced technologies and facilities not available in the country, thus the patient have to be send abroad for specialised	Investment Promotion Act 1994. Article 29 of the Seychelles Constitution make provision for the Government to provide for free primary health care in the State institutions for all its citizens. Over the years the Health budget have systematically increased to cater for the service, demand and development. The National Health Policy derived from the national philosophies, principles and socio – political declaration emphasises the right of the Seychellois people to free access to health care.	Encourages investments that would have otherwise not been viable without Government assistance. Very effective in the sense that every one irrespective of race, religion, colour or position are treated equally.	Time lag from sub projects to approval

	treatment. In 1999 alone the Government spend 18.7 million Seychelles rupees on overseas treatment. New development projects such as the construction / purchased of the oil tanker have potentials for increasing foreign exchange earnings or reducing the foreign exchange out flows. Nevertheless the success of the country's development programmes depends crucially on development / activities in the worlds capital market (out side) which is completely beyond the influence of the Seychelles Government policy.			
Sustainable Markets.	Ministry of Health is the net importer of medicine, medical equipments and other chemicals, and products used in Public Health and Curative Health. The price is dictated by outside (forces) companies and the external development dictates its availability and sustainability. The private medical practitioner / institutions are responsible for their own importations of drugs and equipments so as to upgrade their service to attract clients.	The Procurement Committee review all request for purchasing, and importation of materials / products prior to acquisitions. The non – stock items (drugs) / chemicals is contracted out to International Pharmaceutical Services (IPS)	Demand is considered depending to it's priority / need / urgency and availability of funds. Maintain two months Stock.	Not applicable.
National Legal Institutions.	The Ministry of Health has numerous Acts an Regulations covering several health or health related matters enforced by different Divisions / Sections with the assistance of the Attorney General's Office Most of the existing legislations were drafted during the Colonial time hence they are obsolete and irrelevant for addressing today's	Public Health Act Food Act Quarantine Act Medical Practitioner and Dentists Bill 1994. Nurses and Midwives Act. Termination of Pregnancy Act. Medical Appeals Board Act. Malaria (Subsidiary Legislation)	Some of the Act / Regulations can to a certain addresses some issues affecting public health. Nevertheless note of them make provision for securing the intellectual property rights; property and other risk or development associated.	Obsolete, ineffecti addressing issues present time as mo was drawn be independence.

	accelerated technological health activities and other health issues.	Pharmacy Act Hospital and Dispensaries Act. Misuse of Drugs Act. Mental Treatment Act and others.		
Codes, Standards and Certification.	Several pieces of legislation addresses code, standards and certification issue in the country, including the Ministry of Health to ensure good service delivery and client satisfaction. The Seychelles Bureau of Standards have been mandated to analysed the existing work and amend or produced new ones where necessary.	Seychelles Bureau of Standards – code of practices for use of chemicals. Pesticides Control Act 1996. Treatment Protocol in Draft form. Environment Protection Act 1994. Codes of Practice on standards of Professional Conduct and Medical Ethics. (Doctors / Dentist). Nurses and Midwives Act 1991. Nurses and Midwives (Subsidiary Legislation) 1991. Occupational Safety and Health Decree 1991. Food Control Act. WHO Guide for Spraying of Ships / Aircrafts. International Health Regulation (Spraying of Airport and Port area). National Drug Formulary and Standard Treatment. Treatment Protocol (in draft form).	Good for supporting development and for the monitoring of practices. Ensuring effectiveness of service delivery and the client satisfaction (value for money).	It should be a requirement ar organizations / min private social partn abide to it.
Equity Considerations.	Equity in Health Care depends upon the usage of health care provision by the population. Ninety one per cent of the Seychellois population are literate and there is a high consumption of health care provided by the Government, private practitioners or other alternative medical care such as herbalist, reflexologist etc. Equity means ownership or fairness, whilst the desire to achieve equity	The Seychelles Constitution (Article 29).	Implemented, every Seychellois have equitable access to health care within two – three kilometres distance from their dwelling premises. They also have the option for private practitioner's services. Nevertheless the Government has no control over the cost incurred by the client.	As the guiding stressed the right nation to health environment of e social justice; acc determined by v position but by "Needs" in tha should the qualifie is gross abuse of the

	prevails within a society, it's meaning differs between individuals. The Private Sector helps in giving the equitable health care and reduces the burden on the Government, while the general population tends to abuse the free service provided. The population should develop a sense of ownership and consume health care when is absolutely necessary. To implement a cost effective and equitable health care programme, the Ministry of Health put great emphasis on strengthening and the decentralisation of the Health Care facilities and enhance various preventive measures such as Health Education, Health Promotion, Environmental Health etc. Equitable distribution of Health Care is infinite as health is affected by a number of factors such as diet, education, lifestyle, education, housing and others.	Health Policy Social Security Regulations. Specialised Treatment Fund.	Policies are being drafted. To be finalised before the end of the year 2002.	
Rights to Productive Resources.	Not available at present.	Not applicable	Not applicable	Not applicable
Research and Technology Development.	No written policy available, the Ministry of Health is in the process of drafting one. At present the Ministry apply the Health System Research techniques to strengthen the service provided at all levels. As technology has advanced research and development in the outside world, the Ministry closely monitor the outcome especially in the fields of interest.	Not available.	Not applicable	Not applicable

Assessment of technology options in the sector

The Seychelles Initial National Communication made no proposal for Technology Options in the Health Sector, hence the following options could be considered for implementation:

Proposed Options

In terms of technology transfer in the Human Health Sector, there is a need to ensure that technologies are available at national and local level (Peripheral and Health Facility level) for coping with any changes in the burden of diseases that are associated with climate change. An effective system for the monitoring of health outcomes would be of paramount importance.

(1) Monitoring system for the propagation, infestations (in specific areas, region) and diseases spread by insect / pest of medical importance.
(2) More effective method for rodent eradication.
(3) More effective system for recording any new mosquito species and controlling them.
(4) Appropriate training for capacity building.

Criteria for effective technology transfer

Economic and social criteria

The application / adaptation of an effective monitoring system that could give an early warning to trigger timely actions for controlling diseases, insect/ pest of associated with the effect of climate change can prove to be very cost effective to the Ministry of Health and the population at large. This will prevent the population from being affected and suffer from high fatality rates due to their lack of acquired immunity. (It will prevent an epidemic).

The Integrated Pest Management (IPM) and Control of insect pest can be applied intertwined with the promotional aspect of selected technologies at national and local level. It 's well known that insect / pest species are all highly responsive to changes in environmental conditions (Buckle A.P, Smith R.H and Case Study 2) thus making it essential to develop an understanding of the specific ecological, phonological and climatic factors that influences the propagation in particular situation through research.

Adequate financing

The Ministry of Health is the second largest beneficiary of the government budget. In 2001the ministry obtained the sum of SR 139.6 million for spending which were equivalent to one thousand seven hundred rupees for every Seychellois per annum but with the poor performance of the key sector of the economy, a tighter budgetary situation is expected to develop over the years and this situation is expected to worsen with the declining donor resources which have played an important supportive role in the development of human resources and health care facilities in the past. To ensure continuity of the development process, acquisition of the Environmentally Sound Technologies and capacity building for adequate human resources to oversee the technology transfer process the Ministry would require assistance from the donor countries.

Administrative, institutional and political criteria

As one of their constitutional rights the population have access to free health care from primary to tertiary care if they so wish to use the service provided by the Government or they can use the private doctor facilities for a reasonable fees. The government is committed in the maintenance of a healthy population so that they can contribute actively toward the country's development programme. At the same time access to accurate information is essential when considering the technology to be acquired to sustain or improve the current situation or the population's state of health. The Medical Library at the Ministry of Health, Seychelles Bureau of Standard (Information Centre) Ministry of Environment library or the Internet

could facilitate access to information, while the need to improve the information system and linkages to different important networks should not be overlooked.

Access to technology

The Government should facilitate access to Environmentally Sound Technologies (EST) through enacting measures (enforced Act and regulations, standards, codes) to eliminate as far as is reasonably practicable the obstacles and protect the buyer's/ investor's right.

Administrative burden

To maintain the current national health status might proves difficult for the Ministry of Health as there has been a reclassification of the burden of diseases and other health indicators recently and the population are eager for more sophisticated test and treatment.

The modernization of the health care equipments and technologies to cope with the changing pattern of diseases and the emerging diseases has not proceeded as planned for various reasons. While some of the equipment donated were unable to complement the existing technologies.

At present there is no proper health data collection system in place to support research of climate change related diseases. While there is the need to get the Unit up and running there is a lack of trained personnel to take the responsibility, this is also the case were other professional cadres such as doctors, consultants, dental officers are concern. To date the Ministry still rely heavily on expatriate staff to achieve the set goals. There is the urgent need to intensified efforts and investment for capacity building to bridge the gaps, and allow technology transfer to emulate.

Political consideration

The Government is committed to the improvement of health care and its facilities in all sectors, which could lead to the minimization of health impacts of future climate change. Numerous forms of medical practices in the country can observe at present. Hence the politician will always support expansion and health technology development either in the private sectors or the Ministry of Health.

Replicability

Some of the technologies developed in the small island state can be replicated in other settings with different geographical location and socio economic culture. An example of that is the prevention of the introduction of malaria or other new vector species into the country as speculated in case study No. 2.

Process - related criteria

Market penetration

The evaluation and monitoring of any new technology to be utilised will be important for the country and marketing purposes. Any high transaction costs will definitely affects the requisition process due to inadequate strength of the private medical facilities. The use of indigenous technologies should be encouraged and marketed accordingly. New technologies acquired should boost the present available ones and proves to be beneficial to the system. The fact that the population have shown great concerned over the years about the technologies

being use in the health sector any new application would need to be properly publicizes to create awareness and acceptance of technologies.

Long - term institutional capacity building

Over the year the Ministry of Health have the daunting task of trying to improve its manpower shortage but failed irrespective of the national and international /donor supports due to several other contributing factors. Nevertheless the Ministry of Health should re-look at the whole process which will facilitate the drawing up of a manageable training plan for long term implementation for capacity building and encourages the non-governmental health organisations to follow so as to maximises the benefits of technologies being transferred and maintain the innovation process.

Capacity building would be required at all stages in the process of technology transfer. Health structure and the political commitment evolve with the society's physical infrastructure, institutions and the technologies embodied within them. This requires a capacity of people and organisations to continuously adapt to new circumstances and to acquire new skills.

There should be an on going process for monitoring and evaluation of the impact of service delivery following the introduction of new technologies. Adequate financial resources should be made available to support and sustain such development.

A Stakeholder Typology

Sources and Developers of Technology

The World Health Organisation (WHO) and other Agencies; sponsor most of the health related researches conducted by research institutes all over the world, such as:
Centres for Diseases Control and Prevention (CDC). Division of International Health. Atlanta, Georgia. United State of America.
CIHR. Canadian Institute of Health Research.
Ottawa Health Research Institute.
World Health Organisation (WHO) Center for Health Technology.
Midwest Research Institute (England) (The institute is a an internationally acclaimed center for applied research and technology development).
Pasture Research Institute (France) and many others.
Institute of Health Sciences, University of Oxford. U K (Traditional Medicine).
London School of Hygiene and Tropical Medicine: Kepple Street London, WC1E 7HT. (International School of Public Health , specialising in postgraduate training and research in public health, epidemiology, health policy and infectious diseases.)
There are also some indigenous technologies, which are being developed and adopted by countries in Africa, India, Latin America and others.

Owners and suppliers of technology

Several private firms and state owned agencies are involved in the development and marketing of environmentally sound technologies for the Health Sector:
B ROSENBERG LIMITED
Finchley Avenue. Mildenhall, Suffolk, IP28 7BG
The United Kingdom.
(Specialist in the manufacturing and supplier of medical X-ray illuminators etc)

Killgerms Chemicals Ltd. P. O. Box 2055 ETT. West Yorkshire WF5 9NA. U.K (Supply Chemical for control of insect pest of medical importance.)

AXIM (PTY) Ltd. 121 Gazelle Avenue, Corporate Park. Midrand. South Africa. (Spare parts for medical equipment)

The Scientific Group. P. O. Box13119 Verona Valley 1886. South Africa.
Sigma Aldrich Chemie. Eschenstr 5, D – 82024, Taufhirchen. Germany.

Roll Back Malaria World Health Organisation 20, avenue Appia. CH – 1211 Geneva 27, Switzerland.

Buyers of technology

The Ministry of Health and the private medical organizations purchase the equipments and materials for improvement of the health delivery services.
The most expensive items are those, which are still controlled by a patent and where there is a monopoly of supply. The use of selected essential items not controlled by patents and for which there are a variety of sources, would offers the best opportunity to get value for money in term of cost effectiveness and availability.

Financiers of technology transfer

The government would normally finance's some of the technology transfer in the Health Sector through the yearly budget allocation while the ministry will still require all the support it can muster. The international organizations will need to play a crucial role in the development of such projects.

The private institutions tend to finance their activities through Bank loans.
It would be important for the buyers of the Healthcare technology to ensure that they have the full Healthcare Technology Package (HCTP) when purchasing hardware technology, which includes:

- Planning expenditure on the equipment service;
- Selection of technology;
- Procurement in the international market;
- Installation and operation;
- Maintenance and repair;
- Training in use, and maintenance;
- Technology assessment, research and development;
- Local production.

Information providers

A wide variety of information is required for appropriate and effective decision making, the Government and other private agencies would make available the necessary information pertaining to the technologies being marketed. The review of relevant information produced by other international organisation will be essential for

assessments. If funds are limited, it may be necessary to rely on studies done by others and adapting the results to the local context.

Market intermediaries

The general market development in the country at present involves intermediaries and this will definitely continue in future, especially with technology transfer.

Governments

The government through inter alia, sound regulatory frame works, and economic policy, transparency and political commitments can create an enabling environment for private and public sector technology transfers.

References

Health in the Commonwealth, Challenges and Solutions 1998 / 99. Kensington Publications Limited.

Environment Management Plan of Seychelles 2000 – 2010. Managing for sustainability. Ministry of Environment and Transport 2000.

Health Policy Strategy and Organization in Seychelles. A Sectoral Review for Constructive Reform. December 1995.

Bistoquet Michel: An Assessment of Management Training Needs of Technical Managers in the Ministry of Health. (Dissertation) . October 2001

Methodological and Technological Issues in Technology Transfer. A Special Report of IPCC Working Group 111. Cambridge University Press. 2000.

Ministry of Social Affairs and Manpower Development: Republic of Seychelles National Strategy for the Implementation of the ICPD Recommendations October 1998.

World Health Organization: Climate Change and Human Health: Impact and adaptation. May 2000.

World Health Organization: Climate Variability and Change and their Health Effects in Pacific Island Countries. Report of a workshop held in Apia, Samoa July 2000.

Seychelles Government: Republic of Seychelles National Development Plan 1990 – 1994 Volume 1&2.

Human Resource Development Plan 1994.

World Health Organization / International Development Research Center. Net Gain: A new method for preventing Malaria deaths. 1996

World Health Organization: World Malaria Situation in 1992. Weekly Epidemiological Record 21 October 1994, 309 – 314.

World Health Organization: Strategies for Malaria Control in the African Region and Steps for their Implementation. WHO Regional Office for Africa – Brazzaville 16pp.

Goodman C, Coleman P, Mills A: Economic Analysis of Malaria Control in Sub-Saharan Africa. Global Forum for Health Research May 2000.

Morris Stephen: Health Economics for Nurses An introductory Guide. Prentice Hall Europe 1998.

McKenna Eugene: Business Psychology and Organizational Behaviour. A Student Handbook. Third Edition. 2000.

World Health Organization – UNDP Meyer A.N Consultancy Report: Control of Rats, Rodent –Borne Diseases and Rat Damages in The Seychelles. 1994.

Poiret Danny A.R.: The Knowledge, Attitudes and Practices (KAP) Sustaining a High Level of Rodent and Mosquito Infestation in the Seychelles. Ministry of Health 1998.

Poiret Danny A.R.: Seychelles Climate Change and Health (Project) SEY/G31/A/IG/99. April 1997.

5. Assessment of technology transfer in residential, commercial and institutional sector

Author: Terrence Cooposammy

Introduction

Greenhouse gas (GHG) emissions from the residential, commercial and institutional sector are both from direct and indirect use of fuel to provide energy end-uses. Fuel is used directly for cooking, but this sector relies heavily on electricity as the main source of energy. Electricity is produced from combustion of heavy fuel oil, and this contributes to the emissions of GHGs.

In Seychelles, the residential sector is made up of houses and blocks of flats. As per the 2002 census preliminary results, the population of Seychelles is estimated to be 80,800 (MISD). The number of household is estimated to be 20,895 and over 97 % of these households are connected to the electricity supply system. There were 21,438 consumers in the domestic sector. The commercial sector comprises of service orientated businesses, such as banks, shops, restaurants, tours operators, hotels and guesthouses. There were 2,830 electricity customers in the commercial/industrial sector. The institutional sector is made up of government ministries, hospitals, schools, police station, old people's home, libraries and museums, etc.. There were 677 electricity customers in the institutional sector.

In the residential sector, electrical appliances and equipment are used mainly for lighting, cooking, refrigeration, airconditioning, water heating, ironing, and laundry. LPG is used for cooking in most households. In the commercial sector, LPG is used for cooking and for heat production, apart from that, electricity is the main form of energy for end-uses. In 2002, 287,000 Kg of LPG was consumed in the residential sector, and 36,000 Kg was consumed in the commercial and institutional sector. Electrical appliances and equipment are used for lighting, cooking, refrigeration, airconditioning, water heating, ironing, laundry, office equipment, etc.. In the institutional sector, LPG is used for cooking, and electrical appliances and equipment are used for lighting, cooking, refrigeration, airconditioning, water heating, ironing, laundry, office equipment, etc.. The appliances and equipment used for energy consumption activities are imported mainly form European, South East Asia, China and South Africa.

In 1995, 289TJ of energy was consumed in the residential sector. This was made up of 130 TJ (36 GWh) of electrical energy and 159 TJ fossil fuel (3.73 million litres of kerosene and 159 tonnes of LPG). Almost 70 % of energy used in the residential sector is primarily for cooking. The commercial and institutional sector consumed 276 TJ of energy of which 224.1 TJ (67.8 GWh) was for electricity consumption and the rest in the form of petroleum fuels. In this sector, energy is being used mostly for airconditioning.

The total CO_2 emission for the year 1995 for this sector were 96,395 tonne, of which, direct use of fuels contributed 12,057 tonne, and indirect (electricity consumption)

contributed 84,338 tonne. *It is to be noted that the consumption of 1 kWh or 1 unit of electricity results in the emission of about 0.64 kg of CO_2.* The use of energy efficient technology and renewable energy technology can limit emission of GHG in this sector.

Overview and assessment of national policies and actions that could lead to mitigation of GHG or limit reliance on fossil fuel energy within this sector.

The Seychelles Energy Policy was launched in March 1999 and it is being implemented by the MIIB. The policy vision states '*Seychelles shall focus on increasing the security of its energy supply and energy availability, the implementation of energy conservation practices and enhancing the level of energy services provided*'.

Policy dimension	Applicable policies currently in place	Effectiveness of these policies	Gaps in these policies	Proposals/ Recommendations
National system of innovations	Not formalized yet. There is no University in Seychelles. The S&T policies of Seychelles are presently being drafted by MIIB, the ministry that holds the mandate for S&T, and also for Energy Affairs. R&D in the application of new and renewable energy technology was carried out in the eighties. The EAD of MIIB is monitoring worldwide progress of RET.	Potential use of Renewable Energy Technologies (RET) in Seychelles was assessed in 1986 by Michael Crossetti. It was found that only the use of solar water heater is financially and economically feasible. Refer to "*The Potential for Alternative Energy Technologies in Seychelles, Michael Crosetti, 1986*".	Since policy has not been formalized, there are no strategy and action plan in place at present.	Policies related to national system of innovation needs to be formalized and launch. A leader is needed to drive and implement the policy once adopted. The MIIB need to launch the S&T policy of Seychelles.
Social infrastructure & participatory approaches	Develop an appropriate framework for the proper coordination and collaboration of all energy-related activities.	MIIB receives report of all energy-related activities and is coordinating such activities. The data on fuel import and distribution, electricity generation and usage are kept in computerized databases by the EAD/MIIB.	Climate change issues are not sufficiently addressed. Lack of a process for collecting and managing data for climate change analysis.	A committee should be set up for the coordination and collaboration of all energy-related activities.
Human & institutional capacities	Provide the necessary means for developing human resources in the required areas. Strenghten the energy management functions in the ministry responsible for energy.	There are trained manpower capable of promoting and supporting application of energy efficient technologies	Retaining trained personnel within MIIB to implement such programme. Lack of necessary tools and equipment.	Role and functions of EAD of MIIB need to be re-assessed to ensure that it complement issues of energy use and climate change.
Macroeconomic policy framework	Ensure that the price of energy is adjusted to the correct level	Limit consumption of electricity.	As standard of living rises, people tend to buy more electrical appliances	Electricity tariff must reflect the true cost of electricity production. Tax on

	corresponding to a balance between social, economic and fiscal objectives. Electricity tariff discourages heavy consumption. Use more pay more.		and thereby consumes more energy.	inefficient technology need to be revised. Better control on cheap good that have very short lifespan
Sustainable markets	Elaborate options for promoting the adoption of energy efficient and environmentally sound technology.	There is zero tax on RET and energy efficient technology. Demand for such technology is maintained by consumer education on the benefit of using RET and EET. EET and RET prices are kept low to compete against the other technology.	Lack of foreign exchange to maintain stock of RET and EET. Consumers tend to buy whatever technology is available on the market.	Govt to adopt a policy to have all govt and SHDC houses, hospitals and old people's home to install SWH rather that electric water heater. Government to facilitate the set up of local company to produce SWH.
National legal institution	No R & D to necessitate IPR.	NA	NA	NA
Codes, standards & certification	Use of Certificate of conformance issued by recognized institution to assess technology against standard specification. The NSB (SBS) develop standards and codes of practice for use by industry.	SBS has a conformity assessment process in place to assess conformance of products to standard specification.	Importers need to request for conformance certificate for goods purchased. Import control need to properly enforce the need for conformance certificates.	Codes for airconditioning to be drafted. Training of Custom Officers to assess conformance certificate. Introduce element of energy efficient houses and buildings in the design and approval process.
Equity considerations	Project memorandums are submitted to Cabinet for approval.	Decision makers are made fully aware of projects.	Private sector, NGOs and the public are not fully informed of projects at times	Improvement in the dissemination of information for projects.
Rights to productive resources	NA	NA	NA	NA
Research & technology development	Follow world development in RET & EET, inform the stakeholders and if possible make these technology available in Seychelles.	MIIB is keeping track of latest development in RET & EET. System to evaluate technology must be in place to assess feasibility of using such technology in the local conditions.	Dissemination of information to stakeholders. Making technology available for use locally.	Implementation of a national programme for RET & EET Budget for R & D, and information dissemination.

Case Study 1: Use of Solar Water Heater (SWH)

Keywords: Solar water heater, Electric water heater, Fossil fuel, Electricity production, Electricity bill, Funding mechanism, Capital expenditure

Summary: The project aims were to introduce the use of solar water heater in Seychelles as an alternative to electric water heater, reduce electricity consumption, reduce the fuel import bill and to popularise the use of RET in Seychelles. The target groups were the residential, commercial and institutional consumers that were making use of electric water heaters. The beneficiaries were all customers, the energy supply companies and the country as a whole. The economic benefits were to be derived from the saving on the fuel bill of the country, less capital investment for electricity generation and the saving to the consumers on their electricity bill. The saving that the country made on the fuel bill could be used to finance social projects.

Approach: There is an abundance of solar energy in Seychelles. Solar water heater is a clean technology that requires very little in terms of maintenance requirements. In the eighties, studies of the potential of new and renewable energy were carried out, and it was found that solar energy has the greatest potential for exploitation. In particular, solar water heater was found to be financially and economically feasible for use in the residential, commercial and institutional sector. The cost of using an electric instantaneous water heater was compared to that of a solar water heater. The net benefit or savings that can be achieved from the use of solar water heater was calculated and this information was publicized in the media as a mean of promoting the use of such renewable energy technology. The Government set up a parastatal company to assemble and distribute solar water heater on the local market. This was an initiative taken by the government to build up capacity for such technology, to limit the country's reliance on fossil fuel energy, and also to reduce the fuel bill of the country and help to protect the environment. The government also installed solar water heaters in some of their housing projects, as a mean of getting people familiar with this technology and to establish a local market for SWH. The government was leading by example by this action. Once a market was established, other importers from the private sector, namely business involved in plumbing activities, started to import other brands of SWH for sale on the local market. These businesses provide the full service for delivery, installation, commissioning, and after sales services. The private businesses are presently supplying all demand for SWH. The parastatal company has since closed down, since it could not compete with the other imported brands.

Impacts: The use of SWH in the residential, commercial and institutional sector has had an impact on electricity consumption/demand, and the amount of fossil fuel consumed for electricity production. The consumers that have installed SWH have recorded about Rs 100 (145 kWh) reduction in their monthly electricity bill. The saving made on the electricity bill has assisted with the payment of the capital expenditure for the purchase of the SWH. The use of SWH in this sector has helped to build up capacity for production, installation and maintenance of such technology. The benefit of using SWH has been well reported in the local media and the population is well aware of the benefits for using such technology. The only constraint that has limited wider use of SWH is the initial investment that is needed to purchase a SWH. The SWH is still very much more expensive than an IEWH. A

SWH cost around Rs 6,500, while an IEWH cost around Rs 2,500. Therefore the customers in the lower income group cannot afford to purchase a SWH. Greater use of SWH could be made possible if government could operate some form of scheme with a revolving fund to assist the general public with the initial investment in to purchase a SWH.

Lessons learned: The initial cost for the purchase of SWH is high compared to electric water heater, therefore some form of financial assistance is required if there is to be greater use of SWH in Seychelles. The use of SWH has definitely brought in a saving on the electricity bill and people who have installed SWH have seen the benefit of using such technology. Government support is necessary to assist in maintaining the local market for such technology and this could be made possible if all government houses, SHDC houses and hospitals were to install SWH.

References: SUN 3 Solar Water Heater, TSSD, 1992
Seychelles Energy Bulletin
Project files of TSSD

Case Study 2 Use of Compact Fluorescent Lamp (CFL)

Keywords: CFL, Electricity demand, Energy conservation, Incandescent bulbs, Benefits of CFL,

Summary: The project aim to popularize the use of CFL in the residential, commercial and institutional sector as a mean of reducing the electricity demand and fuel bill, conserving energy, and create awareness of the use of energy saving devices to lower electricity bill. The strategy adopted was to replace as many incandescent bulbs as possible with CFL for this sector. CFL is normally used for security lights. The main target groups were the public in general, governmental organizations, and the businesses. The economic benefit was derived from the reduction in electricity demand and the reduction in fuel bill of the country. The social benefit was derived from the reduction in the electricity bill, thus allowing consumers to make a saving. It was necessary to conduct an intensive awareness campaign to educate the population of the potential benefits of using CFL, even though CFL is more costly to buy compared to incandescent bulbs. The campaign focused a great deal on the residential sector, since people in the lower income group have the tendency to buy the cheapest goods.

Approach: CFL consumes about one fifth the amount of energy consumed by incandescent bulbs, but it gives the same amount of lighting. The use of CFL has been proven to be an easy way to conserve energy and make a saving on the electricity bill. CFL is popularly used in the commercial and institutional sector and has brought about significant savings for various organizations. Though CFL is more costly than incandescent bulb, (one CFL cost around Rs 75 compared to Rs 5 for an incandescent bulb), CFL has a longer operating life (10,000 hrs). A CFL could easily last for a few years compared to a few months for an incandescent bulb. Therefore, in term of the overall cost for the purchase of incandescent bulbs, CFL cost is quite comparably to the overall cost to purchase incandescent bulbs over the normal

lifespan of CFL. The benefit is that CFL bring a saving on the electricity bill, reduces the electricity and energy demand, and also reduces adverse effect on the environment from the release of GHG and other air pollutants that are associated with the burning of fossil fuel for electricity generation.

The EAD/MIIB has been the driving force behind the introduction and use of CFL in Seychelles. The EAD carried out a study to work out the financial and economic benefit of using CFL. The findings were publicized in the media and an awareness campaign was undertaken to educate the population of the benefit of using CFL. The government tried to implement a project to distribute CFL in the residential sector, so as to get more residential consumers to use CFL and for them to experience the saving on the electricity bill. The project did not receive the required funding for implementation and it was shelved. People in the residential sector still find it easier to purchase and use the cheaper incandescent bulbs.

The government has reduced the trade tax on CFL to zero. The importers were made aware of the benefits associated with the use of CFL, and they were encouraged to import and sell CFL. Today, CFL is readily available on the local market. The commercial and institutional sector has made it a must to replace incandescent bulbs with CFL, since such technology bring a saving on the electricity bill, there is also less hassle for regular purchase and storage of incandescent bulbs, and also the replacement of blown bulbs. This exercise to introduce CFL in Seychelles took about one year, and most of the time was spent on the awareness campaign.

Impacts: The use of CFL in Seychelles has had a positive impact on the electricity demand and energy bill. It has contributed in the limitation of emission of GHG from burning of fossil fuel. The economic benefits associated with the use of CFL are the reduction of the fuel bill, reduction in the amount of disposal of blown incandescent bulbs, which can contribute to pollution of the soil with heavy metal, savings for commercial and institutional sector. The introduction of CFL in Seychelles has demonstrated government commitment to conserve energy, limit the emission of GHG and protection of the environment. The awareness campaign on the use of CFL has help to educate the population on the use of energy efficient technology and benefits of energy conservation. The study carried out by EAD/MIIB has help to build capacity and knowledge of the use of energy efficient technology and the evaluation of energy savings associated with the use of such technology.

At present it is not easy to obtain data on how many CFL and incandescent bulbs are being imported in Seychelles. This is one area were the EAD/MIIB should obtain data from the Import Division. Assuming that CFL has a lifetime of 10,000 hrs, a family living in a 2-bedroom house can easily make a saving of Rs 4,400 (5,290 kWh) if CFL is used instead of incandescent bulb. For a 3-bedroom house, the saving that can be made is Rs 7,400 (9,000 kWh).

Lesson learned: Government has a key role to play in facilitating the introduction of energy efficient technology in Seychelles. Simple energy efficient technology can be easily introduced in Seychelles. The EAD/MIIB should continue to monitor worldwide development of energy efficient technology, evaluate their use in Seychelles, and promote the use of such technology. Government should be seen to be leading by example in the introduction of such technology. People in the

residential sector still prefer to buy the cheaper technology, due to their purchasing power. The private sector needs government support to promote the use of EET, since the private sector does not have the capacity to conduct education and awareness campaign.

References: Seychelles Energy Bulletin
Project report for Survey of CFL
Leaflets for CFL by MIIB
Project file

Case Study 3: Use of LPG Stove for Domestic Cooking

Keywords: LPG stove, Kerosene stove, Domestic cooking, Energy conservation, energy bill, clean cooking technology, air pollutants, GHG, Financial benefit, Economic benefit, Social benefit, Health hazards, Environment protection

Summary: The project aim was to eliminate the use of kerosene stove for domestic cooking and to replace it with LPG stove. The objectives were to promote the use of LPG for domestic cooking, to conserve energy, to introduce energy efficient technology in the residential sector, to educate the population on the use of energy saving technology, to reduce the energy bill of the country, save on foreign exchange, to introduce a cleaner cooking technology and thereby reduce air pollutants. The target group was the residential sector and the beneficiaries were both users that have been using kerosene stove for cooking, the SEPEC - the petroleum supply company, and the country and environment as a whole. The expected economic benefit is to be derived from a reduction in importation of the more expensive kerosene and the wider use of the cheaper LPG for cooking. LPG is more efficient than kerosene for cooking purpose. The social benefit will be in terms of the saving on the fuel bill, cleaner cooking environment, as a result of the reduction of air pollutants and eliminate the health hazards of carbon monoxide that is released when using kerosene stove. The project also brought more awareness of the use of EET to the people and education on the need to conserve energy and protect the environment. The use of LGP stove eliminates the hazards associated with the use of kerosene stove. There has been a number of fire incidents that have been due to improper use or failure of the kerosene stove. Usually, this has resulted in explosion of the fuel container, which is made of glass. The distribution and sale of LPG cylinders is easier since it is a prepackaged good. It is easy to store and outlets for sale of LPG cylinders are very close to the residential areas. Kerosene was being sold only at petrol station only, which means that people had to displace over a long distance to purchase kerosene.

Approach: LPG is a more efficient fuel to use for domestic cooking. Less energy is required to complete the cooking activity when LPG is used. LPG stove releases less air pollutants and GHG than kerosene. Inefficient burning of kerosene results in the release of dangerous gases and other air pollutants. These gases and air pollutants are known to be potential health risk and can be detrimental to human health by affecting the respiratory system. The release of carbon particulate as a result of incomplete combustion of kerosene affects the paintwork in the kitchen and therefore demands regular cleaning and painting. The use of LPG eliminates the regular filling

of kerosene tank that is required if kerosene stove is used. Once the LPG cylinder is connected to the LPG stove, it is just a matter of opening the valve to use the LPG. Once the cylinder is empty, another cylinder can be connected to the stove. With LPG stove, there is no need for regular replacement of the wick, and cleaning of the fuel system that must be carried out with kerosene stove. Using kerosene stove also leaves a lot of carbon deposit on the cooking pots, but with LPG this is not a problem, since with LPG you get a complete combustion.

The EAD/MIIB and SEPEC were the driving forces behind this project. The District Administration Office also played an important role to implement the project. The Government and SEPEC contributed to purchase the LPG stoves, LPG and cylinders. The SEPEC had to increase the storage capacity for LPG to ensure a regular and constant supply of this fuel. The MIIB had the data on the number of kerosene stoves that were in use. The data were collected through energy survey and population census. A batch of 10,000 4.5 kg LPG cylinder was imported for distribution under the pilot project. A total of 3,928 kerosene stoves were collected and 3,928 LPG stoves were distributed. The LPG stove was sold a very low cost and each purchaser was given a 4.5 kg cylinder of LPG. In return, the purchaser had to exchange the kerosene stove to benefit under this scheme. The project was implemented at district level. People who were interested to participate in this scheme gave their name to the District Administration Officer. The staffs of MIIB and SEPEC were present at the various districts to distribute the LPG stove and to collect the kerosene stove. The national media did a good job to report extensively on this pilot project and its benefits.

The residential sector has seen a substantial switch from kerosene to LPG for domestic cooking, since 87% of the households are using LPG. The LPG is readily available at various retail points in all districts. The project was implemented over a period of one year. LPG stove is now available on the local market. All importation and retailing of LPG stove is being carried out by the private sector. There is also one private company (P&J Supplies) that is assembling LPG stove locally.

Impacts: The national impact has been the total replacement of kerosene stove with LPG stove and the complete switch from the use of kerosene to LPG for cooking purpose. The SEPEC has reduced the importation of the more expensive kerosene and has increased considerably on the storage capacity for LPG. This has resulted in a saving on the fuel import bill for SEPEC and the country. A more efficient fuel is being used and with less impact on the environment. This project has help to limit the emission of GHG associated with the burning of fossil fuel. It is expected that the risk of fire has been reduced and that health hazards associated with burning of kerosene has decreased. The country has recorded a saving on the fuel bill. The SEPEC had increase capacity for storage and distribution of LPG. The consumers in the residential sector have seen a saving on their cooking bill. The users have benefited in term of purchase of LPG cylinders that are readily available for purchase at various outlet in the districts, compared to kerosene, which was sold only at a few petrol stations on Mahe, Praslin and La Digue.

The project did not have to build capacity for use of such simple technology. The SEPEC had to undertake a major project for storage of LPG to ensure constant supply to the population. SEPEC had to invest in a new LPG cylinder filling plant and a

cylinder testing plant. SEPEC had to double the number of LPG cylinders that were in circulation. Education and awareness on the benefit of LPG for cooking was carried out by MIIB, SEPEC and the SBC. A number of TV programmes were presented to educate users on use of LPG for cooking, and other safety issues.

Lessons learned: Government and its related agencies must continue to play a key role in the introduction of EET. Once technology is proven viable for use, and that there exist a market for such technology, the private sector will take over and maintain the supply of the technology on the local market. The people of Seychelles can adapt easily to these EET and that the education and awareness campaigns are essential for the success of technology transfer. The government should continue to provide incentives for the use of EET to make it more competitive and attractive for use.

References:
Reports of MIIB
Project file
Seychelles Energy Bulletin
Energy Statistics

Assessment of Technology Options

As per the *Seychelles Initial National Communication* to the UNFCCC, the technology options proposed for the residential, commercial and institutional sector are those listed below:

a) Use of energy efficient technology, such as CFL for lighting, refrigerator and freezers for food storage.
b) Use of renewable energy technologies, such as solar water heater.
c) Use of LPG for domestic cooking.

The use of such technologies in this sector in the short to medium term will assist to limit the consumption of fossil fuel, thereby contribute to limit emission of GHGs. The government, through the MIIB, MoE and the NCCC must take the lead role to promote the use of such technologies in this sector. As stated in the case studies, Seychelles being a small economy, the private sector does not have the capacity to undertake survey and initiate energy efficient technology transfer. If the condition is established for doing business and there exist a market for EET and RET, then the private sector would assist in the implementation of technology transfer. Thereafter the private sector would maintain availability of such technology on the local market and provide technical backup to ensure proper performance of such technology.

Use of energy efficient technologies, such as CFL for lighting and refrigerators/chest freezers for storage

The objective is to popularize the use of energy efficient technologies and to ensure that such technologies replaces technologies that consume a lot of energy.

The strategy to use is to undertake pilot projects to distribute such technologies to as many households as possible.

Presently, incandescent bulbs are very commonly used for lighting in the residential sector because these bulbs are cheap and it has been used since electricity was introduced in Seychelles. It is quite common for people to use the wrong rating of bulbs, usually on the high side. All households use refrigerators and some have chest freezers also. Consumers are not properly educated to select energy efficient fridges or freezers. There is the need to find out if it is appropriate for household to be using refrigerator and a chest freezer at the same time. The findings should be communicated to the consumers.

Key issues of stake holders within the sector

Users of technology: There should be an ongoing programme of education and awareness of the benefits of energy efficient technology. The cost for purchasing such technology is the greatest barrier. In the lower income group, people still tend to buy the cheapest available technology. Most of the time, these cheap technologies are

the most energy inefficient and have very short life span. This results in a disadvantage for this consumer group. The people need to be made aware of their obligation to conserve energy and protect environment. The NCCC has a lead role to play in this issue.

Supplier of Technology: There should be continuous education and awareness of the benefits of energy efficient technology to the consumers and the country. The suppliers need to become aware of their obligation to assist to conserve energy and protect the environment. The NCCC has a lead role to play in this issue.

The Facilitator – Government and its Agencies

Government: The MIIB, MoE and NCCC should take the lead role to educate the stakeholders of the benefits of the use of energy efficient technology and to promote and create awareness of the positive effects that such technology can have on environment. The Government should continue to facilitate with the import of energy efficient technology by providing incentives to the importers of such technology. The Government should encourage the other relevant agencies to commit themselves and to be more active with the education and awareness campaign.

Electricity Division and SEPEC: These two national energy supply companies should establish programmes for promoting the use of electricity efficient technology. Both of these companies will benefit in the long term, as a result in the reduction of electricity demand and savings on the fuel bill. These companies could provide the money to establish a scheme to assist consumers in the lower income group to purchase these technologies.

Gaps and weaknesses

Government: There is a lack of human capacity and budget to undertake education, awareness and research in the use of electricity efficient technologies. There should be revision of the tax on energy inefficient technologies.

Electricity Division and SEPEC: These national energy supply companies are usually more concern with their business of maintaining the supply of energy. They do not have energy conservation programme in place, and as such play only a minor role in the transfer of energy efficient technology in the residential, commercial and institutional sector. These organizations should commit themselves to this cause and make it their obligation to reduce energy consumption in this sector, and in doing so, it will help to protect the environment.

NATCOF: This NGO does not have the technical competence at present to address such issue as energy conservation and protection of the environment.

Private sector: They are usually more concerned with the running of their business for a profit. The issue of energy conservation and protection of the environment is seen to be a government concern. They should be made aware of their obligation to conserve energy and protect the environment in the process.

Actions

The following actions are being recommended:

a) Carry out education and awareness campaign for energy efficient technology.
b) Inform users of the benefits of using electricity efficient technology and the potential savings on electricity bills.
c) Implement a pilot project that will assist users to purchase such technology at a reasonable price for them to be able to replace the inefficient technology. A revolving fund can be established to implement this project.
d) Establish cooperation with the private sector for them to continue supplying the technology and after sale service
e) Encourage suppliers of such technology to establish business in Seychelles.
f) Establish a system for disposal of inefficient technology.

Matrix

Technology	Socio-economic needs	Legal needs	Capacity needs
CFL, Refrigerators and chest freezers	Establish revolving fund for assisting with purchase of electricity efficient technology	Revise the trade tax on incandescent bulbs. Use tax collected to finance the revolving fund.	Train personnel of MIIB to carry out assessment of electricity efficient technology. Provide budget for media campaign.

Key Partnership and enabling environment

The MIIB, MoE, NCCC, SEPEC, Electricity Division, Importers/Retailers, NATCOF and Consumers are the key partners.

All partners should be made aware and commit themselves to the obligation and need to conserve energy, reduce the energy bill and protect the environment. Funding is very important to promote and sustain use of electricity efficient technology. The Government should provide fund for the MIIB to carry out study, educate the consumers and carry out awareness campaign with the help of the media. SEPEC and Electricity Division should establish programmes for energy conservation, environment protection, and promotion of the use of electricity efficient technologies in the residential, commercial and institutional sector. NATCOF should start an awareness campaign to cover the use of energy efficient technology for energy conservation and protection of the environment. The private sector should commit itself to promote the use of energy efficient technology for energy conservation and protection of the environment. The consumers in general should be made to commit themselves to this cause, since it will be to their benefit, and at the same time they

will be assisting to reduce energy consumption and the fuel bill, and protect the environment.

Use of Renewable Energy Technologies, such as Solar Water Heater (SWH)

Solar is a clean source of energy that is available through out the year in Seychelles. Every effort should be made to encourage and promote greater use of renewable energy technologies in Seychelles. Solar water heater is one of the RET that has been proven to be financially and economically viable for use in Seychelles. Solar water heater could be use to replace electric water heater, which is more expensive to use and also its use contributes to emission of GHG from electricity consumption. Greater use of solar water heaters would help to reduce the amount of fossil fuel consumption for electricity generation.

The objective is to promote and popularize the use of SWH in the residential, commercial and institutional sector and to replace as many electric water heaters with solar water heater in the short to medium term.

The strategy to use is to conduct a pilot project to:

a) Undertake an education and awareness campaign on the use and benefits of SWH compared to that of electric water heaters.
b) Promote the use of SWH in collaboration with other stakeholders.
c) Establish a scheme for distribution of SWH to replace as many electric water heaters as possible.

Key issue of Stakeholders

Users of Technology: There is the need to have an ongoing programme of education and awareness of the benefits of use of SWH in terms of running costs and that it is pollution free, and the adverse effects that of electric water heater can have on the environment. The cost of SWH is still taken as to be a very high initial investment compared to an electric water heater. There is a need for a financial scheme to be set up to assist consumers in the lower income group to purchase SWH.

Supplier of Technology: There is the need to continue with the education and awareness campaign of the benefits that SWH have in term of running cost, that it is pollution free, and adverse effects that electric water heater can have on the environment. They have to be made aware of their obligation to assist with the conservation of energy and the protection of the environment. There is presently a lack of market for SWH because of its high cost compared to an electric water heater. Locally produced SWH also has a high cost. There is the need for government to support local production of SWH, since it has an overall benefit for the country.

The Facilitators

Government: The MIIB, MoE and NCCC should take the lead role to educate the other stakeholders on the use of SWH. They should promote awareness of the

benefits of such technology and the positive effects on environment. The Government should continue to facilitate with the import of such technology by providing incentives to importers of SWH. The Government should encourage its agencies to be more active and to commit themselves to assist with this campaign for promotion and use of SWH. Assistance should be provided to companies that are producing SWH locally. The Government should adopt a policy to have all SHDC and government houses, hospitals and old people homes to install SWH. This would help to establish the market for SWH and attract the private sector in this business.

Electricity Division and SEPEC: These two national energy supply companies should establish programmes for promoting the use of SWH, since both of these companies will benefit in the long term, as a result in the reduction of electricity demand and the expected savings on the fuel bill. These companies could provide the money to establish a revolving fund to assist consumers in the lower income group to purchase SWH.

NATCOF: This NGO should participate in the education and awareness programme.

Local Markets and Needs

Most households, and all the hotels/guesthouses and hospitals utilize hot water for bathing purpose. Electric water heaters are commonly used for this activity. SWH are more popular in the commercial and institutional sector. For the residential consumers, the cost of a SWH is still considered as a high capital investment compared to an electric water heater. Therefore there is the need to operate a scheme to facilitate the distribution of SWH to the residential sector. The Government should assist to promote locally produced SWH, and provide incentives to companies involved in the production of SWH. The Government should adopt a policy to have all SHDC and government houses, hospitals and old people homes to install SWH. This would help to establish the market for SWH and attract the private sector in this business.

Gaps and Weaknesses

Market Drivers: SWH is still costly to purchase and does not sell as much as electric water heaters. This is the main barrier to transfer of the technology. A SWH costs around Rs 6,500, whilst an electric water heater costs around Rs 2,500. The businesses are not very much concerned with energy conservation and protection of the environment at present because of economic difficulties and foreign exchange constraints. Since most customer still prefers electric water heaters than SWH because of the cost factor, businesses are supplying more electric water heaters than SWH. The businesses should be made aware of their obligations to conserve energy

and protect the environment. All efforts and assistance should be given the businesses to help with the importation and to lower the cost of SWH.

***Technology Drivers*:** There is sufficient human capacity in Seychelles that is familiar with the operation, installation and maintenance of SWH. There is a lack of human capacity within the MIIB to undertake education and awareness campaign and to conduct pilot study for SWH. The national energy supply companies (SEPEC and Electricity Division) should play a leading role as technology drivers and as such they should operate programme to promote the use of SWH. These two companies should be better informed of the benefit of SWH, and they should show commitment towards the effort being made by others to protect the environment.

Legal Drivers: The *Seychelles Energy Policy* was launched in 1999, but there is the need to ensure that objectives of the policy are being implemented. The government should adopt a policy that to have all government and SHDC houses, hospitals, and old people's home to have SWH installed rather the electric water heater. The trade tax on electric water heater should be revised.

Actions

The following actions are recommended:

a) Carry out education and awareness campaign for the promotion of SWH.
g) Inform users of the benefits of using SWH and the potential savings on the electricity bill.
h) Implement a pilot project to assist consumers in the lower income group to purchase SWH at a reasonable cost for them to replace the electric water heater. A revolving fund can be established to finance this project.
i) Establish cooperation with producers of SWH to set up businesses in Seychelles.
j) Establish cooperation with the private sector for them to continue supplying the technology and technical back-up.
k) Establish a system for disposal of electric water heaters that are replaced.

SEPEC and Electricity Division should participate in the implementation of the project. The Government should seek external funding from clean development fund or other environment fund to finance the project. The Government should look into the possibility of re-launching locally produced SWH

Matrix

Technology	Socio-economic needs	Legal needs	Capacity needs
SWH	Establish revolving fund to assist consumers in the lower income group to purchase SWH	Revise the trade tax on electric water heaters. Use the tax collected to finance the revolving fund.	Provide budget for MIIB to carry out survey on the use of SWH and prepare media campaign for

			the promotion of SWH. Facilitate the re-launching of locally produced SWH.

Key Partnership and Enabling Environment

The MIIB, MoE, NCCC, TATCOF, Electricity Division, SEPEC, Importers/Retailers, and Consumers are the key partners for the promotion of wider use of SWH in Seychelles.

All parties should be made aware and should commit themselves to the need to conserve energy to reduce the consumption of fossil fuel, and to protect the environment. Availability of funding is very important to promote and sustain the use of SWH. The Government should provide fund for the MIIB to carry out study, educate consumers and carry out awareness campaign with the help of the media for the promotion and use of SWH. SEPEC and Electricity Division should establish programmes for the promotion and use of SWH. NATCOF should also participate in the awareness and promotion campaign of SWH. The private sector should commit itself to promote the use of SWH to conserve energy and for the protection of the environment. The consumers should be made to experience the benefits of using SWH and the need to protect the environment.

The Government should be seen to be leading by example and this could easily be achieved if all government and SHDC houses, hospitals and old people's home were to install SWH and remove the EWH. This will create the market to sustain business in SWH distribution. A mechanism must be set up to assist residential consumers to purchase SWH. The Government could facilitate the setting up of a joint-venture company to produce SWH locally and provide the necessary incentives to sustain this venture.

Use of LPG for Domestic Cooking

Since the publication of the *Technologies and Measures for the Mitigation of Greenhouse Gases in Seychelles*, the MIIB in collaboration with SEPEC have successfully implemented the *LPG for Domestic Cooking* project as per details given in the Case Study No 3. There has been a complete switch from the use of kerosene to the use of LPG for domestic cooking. There has been no problem associated with the transfer and use of this cooking technology, which has in a way contributed to raise the standard of living and to protect the environment.

There has been an increase in the use of LPG stove and a subsequent decrease in the use of kerosene stove. There is a local company that is assembling LPG stoves for sale on the local market. The transfer of technology has been well implemented and this is assisting to maintain demand of LPG stoves on the local market.

The SEPEC has increase its' LPG storage facilities and capacity at the New Port depot. A new LPG cylinder filing plant and cylinder testing facilities has been set up. Various retail outlets for LPG cylinder have been set up in all districts to facilitate the purchase of LPG cylinder. The transfer of technology has happened as a result of this project.

Other technology transfer options to be considered

Energy management control system for commercial and institutional sector.

More that 75 % of the electrical load for some buildings in the commercial and institutional sector goes toward airconditioning of offices. Energy management control system for airconditioning system could be introduced to manage and conserve energy used for cooling. This could target a system of switching off the airconditioning system when there is nobody in the office or when doors/windows are left open. The EAD/MIIB could play a lead role to carry out energy audits and prepare energy conservation plan.

Reduction of airconditioning load

As pointed above, the high load requirement for airconditioning of offices has a negative impact on the environment and there is a great potential to reduce airconditioning load. This should start with ensuring that energy conservation measures to reduce airconditioning load are introduced in building design and orientation of building. The Planning Authority and Building Control of MLUH could assist to implement energy conservation measures in building. Architects and building contractors could be made aware of the need to design and construct energy efficient building, and to ensure that airconditioning system are properly design and installed. The owners of building should ensure that a proper airconditioning maintenance system is set up and implemented. The Building Codes should be revised to incorporate energy conservation practice.

Criteria for Effective Technology Transfer

GHG and other Environmental Criteria

Obtain information on the energy efficient and renewable energy technologies and proof that such technologies have been tried successfully in countries similar to Seychelles. Establish the potential for limiting emission of GHG from the use of such technology in the Seychelles context.

If necessary or in doubt, carry out demonstration projects to evaluate the technologies under local condition. This will also establish the required local capacity and competency to implement such technologies.

Disseminate the information gathered from the demonstration projects to all stakeholders in order to promote the use of the energy efficient and renewable energy technologies.

Ensure that there is mechanism in place to ensure that the cost of energy efficient and renewable energy technologies are affordable, when compared to the other inefficient technologies. The import duties should be kept very low, and if possible, no duty should be applied.

Ensure that there is mechanism in place to maintain availability energy efficient and renewable energy technologies on the local market, and also spare parts. This is vital to ensure that once a consumer has started to use such technology, there will not be the tendency to switch back to the inefficient and environment unfriendly technologies.

Build up capacity and competency of technical person to maintain and repair the technology. Conduct training courses to upgrade the skill of technicians.

Establish mechanism for Regulatory Bodies to monitor and control import of the technologies.

Collection and availability of data for Evaluating effectiveness of technologies

The EAD/MIIB should continue to collect and complement data collection, processing, storage and dissemination of information for the following:

- Fuel imported and distributed by SEPEC
- Fuel consumed by end users in the residential, commercial and institutional sector
- Fuel used for generation of electricity
- Electricity consumed by end users in the residential, commercial and institutional sector
- Quantity of energy efficient and renewable energy technologies (SWH, CFL, LPG stoves, etc.) imported in Seychelles
- Quantity of electric water heaters, airconditioner, fridges, deep freezers, incandescent bulbs imported in Seychelles

Competent personnel

There is the need to continue to build up capacity for undertaking assessment of technology to evaluate their benefit to limit the emission of GHG, and also other environmental benefit that these technology may have.

Economic and Social Criteria

Costs Effectiveness

SWH/EWH

A SWH cost around Rs 6,500 and the installation cost is Rs 2,000 (total Rs 8,500). An IEWH cost around Rs 2,500 and the installation cost is around Rs 1,000 (total Rs 3,500). Both the SWH and IEWH can have a lifetime of around 10 years. The operating cost in term of energy use for the SWH is zero, whilst that for the IEWH is around Rs 17,000 over a 10 year period. The net savings to be obtained from using a SWH over the 10 years period is around Rs 12,000, or Rs 100 per month on the electricity bill. This saving is quite significant for a normal household in Seychelles. The energy saving is around 145 kWh per month for a household.

As per the 2002 national census (preliminary results, MISD), there are only 1703 houses out of 20,895 houses using SWH. This represents only 8 % of the household of Seychelles that are using SWH. There is no available data on the number of EWH being used, but it is to be noted that 97 % of the household is connected with electricity. Since most household of Seychelles uses hot water for bathing, it is assumed that these households will be using electricity or LPG for heating the water.

This indicates that there is substantial savings to be made as a result of switching to the use of SWH. Therefore the promotion of the use of SWH is a priority.

CFL/Incandescent Bulbs

A CFL cost around Rs 85, whilst an incandescent bulb cost around Rs 5.5. A 3-bedroom house will have around 25 light points. The rating of buls would be of 40 or 60 watts, whilst that of CFL would be 9 or 13 watts. A CFL has an operating life of 10,000 hours, whilst that of a bulb is around 1,000 hours. Total cost for purchasing CFL is Rs 2,125, whilst the cost for bulbs would be Rs 1,375 (for 10,000 hours of operation). The operating cost of CFL in terms of energy use is around Rs 1,000, whilst that of bulbs is around Rs 4,700. The total cost for using CFL is around Rs 3,125, whilst that for bulbs is around Rs 6,075. The total saving for a 3-bedroom household could be around Rs 2,950. The energy saving is around 4,275 kWh per household, and it is to be noted that there are 20,895 households in Seychelles.

LPG Stove/Electric Cooker/Kerosene Stove

As per the 2002 national census report (preliminary results, MISD), there are 18,091 LPG stoves (87 %), 409 kerosene stoves (2%) and 1386 electric cookers (7%) used for cooking in the 20,895 households of Seychelles. It is to be noted that 4% of the households are using either charcoal or wood for cooking, or does not have to cook.

The Government effort to promote the use of LPG as a cheaper alternative to electricity and kerosene for cooking has been successful.

Adequate Financing

The Government should seek technical assistance from GEF or other Clean Development Fund to set up a scheme to assist consumers in the lower income group with the purchase of SWH. The PUC and SEPEC should also provide financial contribution to assist with the operation of this scheme. Foreign exchange must be made available for the importation of SWH, CFL and other energy efficient technology. The suppliers of energy efficient technologies should be encouraged to contribute towards the financing scheme.

Administrative, Institutional & Political Criteria

Information about technology

The CISTID of the SBS, EAD of MIIB, the NCCC, the Documentation Centre of MoE, Electricity Division and SEPEC have all got a key role to play in the dissemination of information about the technologies to the buyers and users. There should be more articles in the local newspaper, radio and TV about energy efficient technology. There should also be regular talk to students through cooperation with the MEY. The NCCC should look into the possibilities of organising workshop/seminars to cover energy efficient technologies.

Access to Technology

Due to foreign exchange constraints, this has limited the buyer's access to energy efficient technologies. It is common for goods such as CFL and SWH to be out of stock on the local market. The present cost of SWH is a major barrier of access for those in the lower income group.

Administrative Burden

There is presently a big gap and a lack of mechanism for information collection to assess effectiveness of energy efficient technologies. It is quite difficult to obtain import data for such technologies, or data on the number of SWH in use. There is capacity within the MIIB to maintain such data and as such, mechanism for data collection, processing, storage and access should be set up. The lack of accurate data is a constraint for analysis of the contributions of energy efficient technologies on climate change.

Economic Considerations

The availability of foreign exchange for the importation of energy efficient technology must be considered. The Government should adopt a policy that make it a must for all government and SHDC houses, hospitals, and old people's home to install SWH. The Government should also encourage hotels on outer islands to install SWH and PV system as a mean of limiting the transportation and use of fossil fuel on these islands. This could form part of the Go Green initiative.

Replicability

Introduction of SWH, CFL and LPG stove have demonstrated the fact that the population can easily adapt to energy efficient technology. Since there are benefits associated with the use of such technologies, the population has continued to utilise these technologies.

Process-related Criteria

Market Penetration

Both SWH and CFL are in demand on the local market, but availability for retail and the price of these goods have affected the potential for wider use by the population.

Long-Term Institutional Capacity Building

The population has already adapted to the use of SWH, CFL and other energy efficient technology, and these technologies have been made available on the local market for a long time. The EAD of MIIB has the responsibility for assessing the use of energy efficient technology and the staffs have been trained to carry out such assessment. A mechanism should be set up to assist consumers in the lower income group to purchase CFL and SWH. The Government, PUC and SEPEC should contribute to maintain the funding mechanism. The suppliers of the technology should also be encouraged to participate in the funding mechanism and distribution of energy efficient technologies. Training should be provided to cover the use of load management control. The management of PUC and SEPEC should be encouraged to set up programmes for energy conservation in the residential, commercial and institutional sector and for the protection of the environment.

Monitoring and evaluation of continuous delivery of services provided by technology and adequate financial performance

Delivery of services by technology: normally SWH and CFL have a longer operation life than electric water heater and incandescent bulb respectively.

Actual and intended benefits: the use of SWH and CFL will result in a reduction of the electricity bill, thus a saving for the customer.

Performance of technology: the performance of SWH and CFL has already been proven to be very satisfactory and has indeed delivered the expected benefits.

Quality of benefits: this is satisfactory since customers have continued to make use of the SWH and CFL.

Satisfaction of beneficiaries: customers in the low-income group are not happy with the price of SWH and CFL. They would like to see a price reduction for these goods.

Importers of SWH and CFL are not happy with the access to foreign exchange to import these goods for the local market.

Distribution of benefits: SEPEC could fund a pilot project from the savings obtained from the LPG project.

Maintenance and service of equipment: capacity exists and service is being provided.

Payback period: this is still too long for SWH, because of the high price of SWH.

A Stakeholders Typology

Sources and Developers of Technology

There is no ongoing R&D of energy efficient technology at present. Technologies are imported from various countries. In the eighties, R&D for RET were undertaken by the TSSD of the Ministry of Industry.

Owners & Suppliers of Technology

These are all overseas companies and some of the more popular one are listed below.

CFL:	Philips,
SWH:	Solarhart, Solarprimeg,
Fridges:	Frigidaire, Kelvinator, Zanussi, LEC, Electrolux, etc..
Aircon:	General Electric, FUJI Electric, Chigo, Kelon, National, Ascon, etc..

Buyers of Technology

The importers of these technologies are listed below.

CFL:	P&J, SMB, Adam Moosa, Dhanjee, Bodco, etc..
SWH:	P&J, Rapid Roofing, Best Way
Fridges:	Ahbaye, Bodco, P&J, Kim Koon,
Aircon:	HIS, SMB, Top Cool, Unique, etc…

Financiers of Technology transfer

This can be any of the commercial banks, or the Development Bank of Seychelles and also companies in the private sector that are investing their own fund to purchase the technologies.

Information Providers

The CISTID of SBS, MoE Doc Centre, MIIB/EAD, Importers, websites of UNFCC, and websites for clean technology, energy conservation technology, etc.

Market Intermediaries

There are some consultants who are providing energy management consultancy services in the commercial sector.

Government

The Seychelles Energy Policy was launched by the MIIB in March 1999. The Government has reduced trade tax for energy efficient appliances to zero. The EAD/MIIB is maintaining ongoing energy conservation programme and other related energy programme for the implementation of the energy policy.

Acronyms

CFL	Compact Fluorescent Lamp
CO_2	Carbon Dioxide
EAD	Energy Affairs Division
EET	Energy Efficient Technology
GEF	Global Environment Fund
GHG	Green House Gas
IEWH	Instantaneous Electric Water Heater
DWh	Kilo Watt Hour
LPG	Liquid Petroleum Gas
MIIB	Ministry of Industries and International Business
MoE	Ministry of Environment
MISD	Management Information System Division
MLUH	Ministry of Land Use & Habitat
NATCOF	National Consumer Forum
NCCC	National Committee for Climate Change

NGO	Non-Government Organisation
R&D	Research and Development
RET	Renewable Energy Technology
SBS	Seychelles Bureau of Standards
SEPEC	Seychelles Petroleum Company
SHDC	Seychelles Housing Development Corporation
SWH	Solar Water Heater
S&T	Science & Technology
TJ	Tera Joule
TSSD	Technological Support Services Division
UNFCCC	United Nation Framework Convention for Climate Change

References

Environment Management Plan of Seychelles 2000-2010, MoE, 2000

Seychelles Initial Communication to the UNFCCC, MoE, 2000

Greenhouse Gas Inventory of Seychelles, NCCC, 1997

Technologies and Measure for the Mitigation of Greenhouse Gases in Seychelles, NCCC, 1998

The Potential of Alternative Energy Technologies in Seychelles, Michael Cosetti, 1986

Seychelles in Figures, 2003 Edition

Seychelles Energy Policy, MIIB, 1999

SUN3 Solar Water Heater, TSSD, 1992

Seychelles Energy Bulletin

Information on CFL, MIIB

Report on the Promotion of LPG for Domestic Cooking, MIIB

6. Assessment of Technology Transfer in the Industrial Sector

Author:

Introduction:

The Seychelles industrial sector is composed of manufacturing activities and other industrial related services such as tourisms, fishing, agriculture, onshore and offshore businesses. The manufacturing sector's activities inherit a great possibility of contributing heavily to the emission of GHG gasses, by means pollutants from the combustion of fuel.

This sector is composed of mainly two groups of firms, namely:

1. Manufacturing of food products and beverages, and,
2. Mining, quarrying and construction.[3]

In view that these industries are capital based, they depend heavily on transferred technology. Oweng, J. B. et al (1995: 88) defines technology transfer as:

> … the means of transferring technology from one country [*technology supplier*] to another [*technology recipient*] … [*by focusing on]* the communication of knowledge, skills and methodology involved in production and distribution of goods and services in the economic development of nations. For an effective transfer process, the technology involved should match the cultural, socio-economic, and above all, the environmental conditions of the recipient countries. [*Besides*]… the necessary capacity in place to absorb the technology … involves operational, maintenance, adaptation and innovative skills.

The various issue raised in the above quotation will be the basis for the development of this paper, especially with specific reference to the impact of GHGs on our pristine and fragile environment.

Technology transfer as related to the manufacturing sector has been contributing to the GHGs emission in our atmosphere, although minimal. For instance, in 1995, industrial uses of fuel oil amounted to 960, 000 litres, kerosene at 37, 100 litres and 863, 955 litres of gas oil were used for heat processes. In the case of the former, industries such as the Indian Ocean Tuna Ltd, SeyBrew, the Seychelles Marketing Board – Fish Division, Meat Division, Agro-Division, Animal Feed Division, Tea Company, and so forth, used fuel oil. Kerosene was used to generate heat for the production of polystyrene packing for fish by SMB.[4] GHG emission from these factories is as summarised below.

[3]Government of Seychelles (2000: 40) Seychelles Initial National Communication (2000: 40)
[4] Ibid.

Table: **Emission (in tonnes) from Industry in 1995**[5]

GHG	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
Emission 9tons)	5., 528	0.204	NA	15. 750	12. 254	NA
Share in Total	3. 090%	1. 790%	NA	2. 670%	0. 240%	NA

The government of Seychelles encourages cleaner production practices, guided by the vision of its industrial policy, which states that:

> Seychelles shall remain free of heavy industries which may destroy their fragile and prestine environment. Emphasis will be placed on viable light industries which are aimed at import substitution and exports and creation of employment.[6]

This is done in such a way that preventive rather than end – of the pipe approaches are favoured. Manufacturing projects are thus screened by government thus to ensure that the conformance to environmental regulations related to industrial activities.

It is estimated that if the situation remain similar to the current situation, there could be a 5% increase in GHGs released in our environment annually.

[5] Ibid.
[6] … Government of Seychelles (1996) Industrial Policy and Strategy For Local (Non – Sitz) Industries

POLICY DIMENSION	APPLICABLE POLICY CURRENTLY IN PLACE	EFFECTIVENESS OF THIS POLICY	GAPS IN THIS POLICY	PROPOSALS/ RECOMMENDATIONS
National Innovation Systems	Encourage firms to innovate and import technologies so as to reduce GHGs.	A few firms have innovated their technologies to reduce GHGs.	Science and Technology policy and strategies still in draft form.	Finalise explicit science and technology policy and strategies for implementation
			Firms lack innovation capabilities	Assist firms to build technological capabilities
			Lack of institutional and organisational structures to support technological development and innovation.	Establish a steering committee to spear head the local technology sector.
			Lack of a proper research institution, equipments and adequate manpower.	Establish a proper research institution and upgrade SBS capabilities by means of capital goods and human resources.
			Lack of industries to further research and develop capital goods.	Develop the capital goods industries.
			Absence of high-level scientific and technical educational institutions.	Further develop scientific and technical education institutions to graduate and postgraduate levels.
			Inadequate updated information pertaining to science and technology, and GHGs issues.	Make information pertaining to technology available to the public through libraries, documentation centres, on the internet, etc…

POLICY DIMENSION	APPLICABLE POLICY CURRENTLY IN PLACE	EFFECTIVENESS OF THIS POLICY	GAPS IN THIS POLICY	PROPOSALS/ RECOMMENDATIONS
Social infrastructure and participatory approaches.	Government shall gradually adopt the role of facilitator thus allow other stakeholders to take a leader stance vis-à-vis appropriate technology transfer.	Entice the private sector, NGOs, informal communities and social movements to contribute to the environmental aspects of appropriate technology transfer, diffusion, adaptation, fusion, absorption, etc…	Lack of NGOs who are environmentally conscious vis-à-vis technology issues.	Organise workshops to sensitise NGOs on appropriate technology transfer projects, so that small technology-based projects can be implemented at home level as well as nationally every day, i.e. technology becomes part of our lives.
			Lack of private sector participation in the issue of technology transfer.	Further encourage the private sector to take a leader stance to the issue of technology transfer.
			Local communities lack sensitivity as to how technology transferred affects their neighbourhood.	Organise local community to assess the impact of technology transfer on their environment.
			The issue of technology transfer is taken for granted and interpreted to imply capital equipment/machinery only.	The true meaning of technology needs to be explaining rationally for better understanding.
			Lack of local community's participation with regards to technology transfer.	Encourage the local community to assess and comment on technology transfer projects.
			Lack of technology transfer and environment oriented social movements to influence Government's decision.	Establish a Steering Committee to influence and guide Government on issues related to technology transfer.
			Lack of local media technology transfer programmes at the right academic level to influenced the mass of population	Allocate a slot on television and radio programmes and a column in the local papers as well as in other publications on technology transfer.
			With the absence of explicit technology Policies and Strategies the Ministry responsible for technology issues (MIIB) and its executive agency responsible for same *SBS) have up to now remained relatively passive vis-à-vis technology development.	MIIB in relation to SBS must become more active vis-à-vis technological development through development of specific projects for implementation with the collaboration of the private sector.

POLICY DIMENSION	APPLICABLE POLICY CURRENTLY IN PLACE	EFFECTIVENESS OF THIS POLICY	GAPS IN THIS POLICY	PROPOSALS/ RECOMMENDATIONS
Human and institutional capacities.	1. Government will endeavour to find further ways and means to ensure that labour becomes increasingly more skilled in order to bolster innovative capabilities of our personnel in the private sector and parastatal organisations.	Training and recruitments of a few qualified technology-oriented locals, including trainers.	Lack overseas work attachment and training for locals.	Offer more overseas training as well as attachment/scholarships.
			Lack of technology transfer management skills – assessing, selecting, adapting, etc…	Offer training in technology transfer management/SIM curriculum.
			Lack of well-qualified labour in technology transfer especially regarding GHGs and technology.	Offer local training in the technology transfer sector.
			Firms, non-governmental organisations, regulatory organisations lack capacities.	Increase capacities of the firms, NGOs and regulatory organisations.
	2. The revamped Bureau of Standards (SBS) will increasingly offer a series of services to industrial sector, ranging from free advisory ones to tests and issuance of certificates of standards.	A number of local industries have been assisted to eventually obtain the International Standard Organisation (ISO) certificates.	Lack scientific and technical skills.	Offer training to boost scientific and technical skills at secondary level education.
			Lack of physical resources / equipment.	Source external donors for physical resources and equipments.
			Lack appropriate infrastructures.	Construction of appropriate infrastructure.
			Lack of mechanism to continuously update on technological issues.	Set up appropriate mechanisms to facilitate the review and updating on technological issues.
			Lack of national procedures to assess, select, adapt and finance appropriate technology transfer.	Establish national procedures to assess, adapt and finance appropriate technology transfer in Seychelles.

POLICY DIMENSION	APPLICABLE POLICY CURRENTLY IN PLACE	EFFECTIVENESS OF THIS POLICY	GAPS IN THIS POLICY	PROPOSALS/ RECOMMENDATIONS
Macroeconomic policy frameworks.	Government shall promote industrial – technological -investments, which are environmentally, financially and economically viable.	Encouraged the establishment of small and medium size enterprises, in which technologies are major components, which would render them more efficient, productive and price/quality competitive.	Lack of easier access to capital.	Encourage projects that generate forex in order to sustain the technology sector. Establish a scheme to finance technology only (i.e. capital equipment, etc…
			Lack of foreign exchange.	
			Lack of invitation for public's views regarding technology transfer projects as in the case of Environmental Impact assessment.	Rigorously invite the public to assess and consider projects that are submitted for approval.
			Lack of project ideas for public's considerations.	
			Lack of proper assessment of technological aspects of projects at technical level.	
	Government shall increasingly place emphasis on productivity and competitiveness; and limit protection (by way of tariff and non-tariff barriers) to industries for the period of infancy only. Government shall provide business tax concessions on capital goods	Loans have been granted for the purchase of technologies (equipment). Indirect financial support, like trades tax concessions on capital goods import has been granted to firms.	Lack of scientific knowledge and skills pertaining to productivity.	Offer more high-level trainings.
			Lack of productivity laboratory.	Establish a productivity laboratory.
			Lack of innovation (Research & Development mechanisms) capabilities of firms.	Train and subsidise firms that are involved in innovation.
			Some firms are ignorant of trades tax concession facilities.	Raise public awareness of concessionary tax through media.

POLICY DIMENSION	APPLICABLE POLICY CURRENTLY IN PLACE	EFFECTIVENESS OF THIS POLICY	GAPS IN THIS POLICY	PROPOSALS/ RECOMMENDATIONS
Sustainable markets.	Government is assisting and promoting private sector initiative vis-à-vis reduced – GHGs technology transfer.	In terms of soft wares, there have been numerous ideas developed with export potentials.	Lack of research to determine technology supply and demand priorities.	Conduct a market research.
			SMEs lack financial ability and often the willingness to adapt technology.	Government/private firms should provide such services.
			Lack of research and development of indigenous hardware by local SMEs.	Government/private firms should provide such services.
			Uncertainty of local markets for hardware.	Consider SADC or COMESA member countries as potential markets.
			High research, development, and transaction costs.	Government could subsidise.
			Lack of consumer awareness and acceptance of locally made technologies.	Raise public awareness through media.
			Small domestic markets and difficulties/constraints in exporting dampen urge/incentive to invest in R & D.	Consideration of the IOC/COMESA/SADC markets should be considered.
			Lack of scientific and technical skills in developing technologies.	Provide more training and assistance from local private firms as well as foreign ones.
			Too dependent on adoption of imported technologies.	Devise a program geared towards innovation and adaptation of technologies.
			Lack of assessment and evaluation of the energy aspects of technology.	The energy aspects of technology must be better scrutinised.

POLICY DIMENSION	APPLICABLE POLICY CURRENTLY IN PLACE	EFFECTIVENESS OF THIS POLICY	GAPS IN THIS POLICY	PROPOSALS/ RECOMMENDATIONS
National legal institutions.	Government shall establish appropriate mechanisms to ensure that technologies are legally protected.	Scope is there for Technologies invented /developed and innovated locally to be registered.	Lack of a strong framework for intellectual property protection. The Act itself is not adequately 'marketed' and, many businesses or operators hardly know about its existence, meaning and uses.	Need to further strengthen frameworks for intellectual property protection.
			Producers and consumers lack information of legal procedures related to intellectual property protection.	Producers and consumers need to be more aware of legal procedures related to intellectual property protection.
			Lack the involvement of the private sector and NGOs in the policy decision-making processes.	Increase the involvement the private sector and NGOs in the policy decision-making processes, on the Technology Steering Committee.
			Administrative procedures for intellectual property protection lack clarity.	Administrative procedures for intellectual property protection needs to be simplified and more user friendly
			Lack of publication of protected intellectual property for the benefits of the public.	Publicise protected intellectual property in a gazette.

POLICY DIMENSION	APPLICABLE POLICY CURRENTLY IN PLACE	EFFECTIVENESS OF THIS POLICY	GAPS IN THIS POLICY	PROPOSALS/ RECOMMENDATIONS
Codes, standards and certification	The Seychelles Bureau of Standards (SBS) will offer a series of services to the industrial sector ranging from codes, standards and certification.	Some codes, standards and certification procedures have been developed and implemented.	Lack of test and measurement facilities in certain areas.	Seek foreign assistance to purchase appropriate instruments.
			Lack of institutional framework and human resources in certain areas to enforce standards.	Evaluate and amend existing framework to enforce standards.
			Lack of government agencies capability to promote technologies.	Beef up government agencies to promote technology.
			Lack of information regarding Technologies, their characteristics and their producers/ manufacturers.	Source relevant documents, manuals, etc… to supplement and update existing ones.
			Lack of private firms capabilities to monitor and reinforce owns' internal standards or maintain consistency.	Raise private sectors' awareness of the need to do so.
			In certain circumstances, lack of codes and standards.	Adapt and further develop new codes and standards.

POLICY DIMENSION	APPLICABLE POLICY CURRENTLY IN PLACE	EFFECTIVENESS OF THIS POLICY	GAPS IN THIS POLICY	PROPOSALS/ RECOMMENDATIONS
Equity considerations.	Government shall gradually adopt the role of a facilitator in the technology transfer processes.	Informally, the private sector, NGOs and the public at large have aired their views especially where technology transfer is detrimental to the environment.	Lack of analytical tools.	Adapt and develop new analytical tools.
			Lack of training and opportunities for social impact assessment.	Provide training and opportunities for social impact assessment.
			Lack of technology social impact assessment before technology is selected and after implemented at regulatory organisations' level.	Encourage technology impact assessment of technology projects as and when needed, at regulatory organisations' levels.
			Lack of compensatory mechanism for the losers.	Establish compensatory mechanisms for losers.
			Lack of social impact assessment of all stakeholders, other than that of government, either directly or indirectly affected by the technology transferred.	Involve all stakeholders, other than that of government, in social impact assessments.

POLICY DIMENSION	APPLICABLE POLICY CURRENTLY IN PLACE	EFFECTIVENESS OF THIS POLICY	GAPS IN THIS POLICY	PROPOSALS/ RECOMMENDATIONS
Rights to productive resources.	Government shall assist the industrial sector as much as possible in overcoming constraints relative to factors of production.	Government has intervened thus take possession of a location where raw materials are available which is claimed to be a private property.	Lack participation of the private sector and NGO's in the formulation of the policy and strategies pertaining to the " rights to productive resources".	Ensure the participation of all stakeholders in the formulation and implementation of the policy and strategies pertaining to the "rights to productive resources".
			Technology being a factor of production often needs to be negotiated. An SME, being small, may not have strong enough bargaining power to negotiate with the technology supplier.	There need to be a Government mechanism to assist SME's in this direction.

POLICY DIMENSION	APPLICABLE POLICY CURRENTLY IN PLACE	EFFECTIVENESS OF THIS POLICY	GAPS IN THIS POLICY	PROPOSALS/ RECOMMENDATIONS
Research and technology developments.	Government shall assist the private sector to carry out R&D to boost up the performance of the sector, and shall also be involved in such activities as when deemed necessary.	Taking into account domestic constraints, a number of prominent ideas have come forth from the private sector and government is studying some other possibilities.	Inadequate public research laboratories.	Establish at least one public research laboratory.
			Lack of identified research grants.	Source international research grants.
			Lack of strong science and technical educational system.	Source possibility for regional high-level science and technical study opportunities.
			Lack of investment in research and development.	Government could consider the funding of R&D.
			Lack of science and technology related educational infrastructures.	Source external funding to establish science and technology related infrastructures.
			Lack innovation capacity of indigenous technology at governmental and private sector levels.	Study the possibility of innovating indigenous technology at government and private sector levels
			Lack of a captive market to sell such technologies developed or to exploit them commercially given major export constraints.	There is a need for regional/international market research to establish a captive market.

Case Study 1: Water Boiler Consultancy Services

Keywords: Water boiler, Diesel, Heavy Fuel Oil (HFO), Cost Reduction

Summary: This project is intended to provide consultancy services to clients in Seychelles, wishing to install water boilers for industrial uses. The idea started by the owner of the consultancy service, who identified the need to procure new water boilers for his company. He then went overseas to take a short course into how such devises could be installed and serviced. After he came back, he started to promote the services he decided to provide to a number of key organisations that were using water boilers, namely, SMB, Seybrew, and five star hotels. As the manager of the service points out, the main advantage of the water boilers he is importing is that they use heavy fuel rather than diesel, which is more expensive. The main selling strategy is to convince clients that their fuel bills can be reduced by at least half, if they fuel their boilers by heavy fuel oil (HFO).

Approach: The water boiler consultancy project is an entirely private sector's initiative. The owner of the company identified the need for new water boilers and to innovate the existing water boilers around the islands with the aim of cutting down on the fuel costs, based on his own needs as a tyre-rethreading company owner in the Seychelles.

The target groups of the consultancy company are manufacturing industries such as the Seychelles Marketing Board (SMB), the Seychelles Breweries (SeyBrew) and five star hotels around the islands. They use water boilers to either produce steam for heating water or to heat up water for use in their industrial processes or for direct consumption. The major problem that was identified by the Consultancy Service manager is that to heat up water, using diesel as the fuel for the machine, was not economically viable in view that the cost of diesel is higher than that of heavy fuel. For instance a litre of diesel costs SR. 5.00 and only SR 2.50 for heavy fuel oil.

Impacts: One of the major visible impact is that industries using boilers using HFO, reduces its fuel bill by 50%. Furthermore, in view that the amount of hot water needed by these industries are in large quantity and usually for 24 hrs on 24 hrs, the use of electricity would have cost a fortune. Besides, if solar water heaters were to be used, then this would have created problems of supply, especially during nighttime. In all, in the case of industries, the consultants indicated that the best option is water boiler, in view that they can provide both steam and hot water, for longs hours and in larger quantities.

It is no wonder then, that despite the number of local clients for such a technology is limited for the time being, they are all happy with such a technology. Some of them that were using diesel to fuel their boilers have now turned to heavy fuel oil option due to cost reduction in fuel consumption rather than the reduction in GHGs. HFO is much dirtier than diesel and causes more air pollution and probably not good for the greenhouse.

The maintenance of these boilers is very important. If the machine is new, then there would be minimum GHGs released in the environment. This is why the consultant quoted the need for the machines to be serviced on a daily, weekly, monthly and yearly basis, based on the schedule, which determines clearly the type of maintenance needed for each interval.

Being the only Seychellois trained, hitherto, to install and service these water boilers, the manager indicated that one other Seychellois is undergoing training abroad at the company's expense, so that he is also qualified to undertake such tasks upon his return. He also indicated that in the short to long term, this project will not only have a major impact with regards to the lower amount of electricity used to heat water for industrial uses but also create employment opportunities for other Seychellois. This is likely so, in view that there is a growing number of five star hotels being built around the island at present and also in due course.

Up to now, it is only the well-established businesses in need of hot water for their industrial uses that can afford for such a technology. The manager indicated that for such businesses, the price of these machines is bearable. Price wise, there is no problem at all.

Lessons learnt: This project being completely private sector driven shows the importance of the initiatives taken by the private sector. The major impact is that of reduced fuel costs by 50%. Besides, such a company will definitely have major socio-economic impact such as job creation and training of personnel. The trained manager of this consultancy project is no doubt a very good source of information provider and also advisor to industries wishing to purchase such technologies, but fail to obtain adequate technical information that would enable informed decision-making. There is a strong need for the manager of this project to be invited on to the various meetings regarding the issue of environment with regards to the issue of reducing GHGs, being released in the environment, thus enable better understanding vis-à-vis this issue. Other than his newly acquired knowledge about water boilers, such an opportunity will enhance awareness of environmental issues that ought to be stressed to clients as and when they are advised. Above all, this will enable the manager of this consultancy service to choose the best environmentally friendly water boilers, with due considerations to their technical efficiencies, which is the focus at present. Again, it is seen that the point of concern is that of reduction in cost rather than reduction of GHGs.

Case Study 2 – Seychelles Breweries Limited – The Use of Water Boiler

Keywords: Seychelles Breweries Limited, Diesel, (RFO) Heavy fuel oil, Direct Digital Combustion Control.

Summary: SeyBrew is a privately owned company. It produces a whole range of drinks such as Guinness, beers, and lemonades for the local consumption. The high demand for such products is continuously increasing, resulting in a parallel need for large quantity of hot water for the manufacturing processes. The water boiler in use by Seybrew formerly used only Diesel, as fuel. However, after consulting their parent company in Germany,

SOTRATECH LIMITÉE in Seychelles as well as SBS, SEYBREW decided to turn its water boiler into a dual fuel system. At present, the boilers use both diesel and HFO as fuel. Generally, the Seychellois engineers at SEYBREW planned and carried out the innovation on the water boiler. However, SEYBREW sought the help of its parent company in Germany to install the Direct Digital Combustion Control Unit.

Approach: It is a well-known fact that heavy fuel is crude, and heavy. Due to its characteristics, it could emit a lot more GHGs compared to diesel, especially if the machine is not well maintained. It is also clear that the only criteria being used by industries in choosing HFOs fuel system for their water heaters correlates to reduced fuel costs.

Any company, having to meet a large and continuously increasing demand for its products resulting into an equally high need for hot water, would consider the cost of fuel as a priority with the aim of cutting down on factory overheads. SEYBREW is not an exception despite the fact that its yearly profit is quite remarkable.

The water boilers in use by SEYBREW was using only diesel to fuel its heater. Having considered the lower cost of RFO, SEYBREW decided to carry out a research, by consulting both local and international experts in the field, to see how best it can turn its water boilers into a dual fuel system. SEYBREW engineers designed and sought further advise from its parent company in Germany for innovating its water boilers. Having been given the green light, the engineers at SEYBREW modified the fuel system in such a way that both diesel and RFO could be used. One of the engineers quoted that diesel fuel is now only used if there is a lack of fuel or if the RFO fuel line is faulty. Otherwise, the RFO is constantly being used.

In view that HFO emit more GHGs, SEYBREW contacted its parent company in Germany to seek help to install a Direct Digital Combustion Control to the fuel system. This device is completely computerized, to control the amount of air and fuel intake, thus limiting the amount of GHGs such as CO2 and other invisible and odourless gases emitted.

However, the Direct Digital Combustion Control is not enough to ensure that minimum GHGs are released in the environment. Well-trained engineers and technicians coupled with continuous maintenance on these water boilers are also elemental if the amount of GHGs released, are to be minimised at all times. To quote the SEYBREW Engineer interviewed, '… to rely only on the Direct Digital Combustion Control would not help minimise the amount of GHGs released in the environment; … but above all, there is a strong need for the maintenance schedules to be strictly respected, followed and the maintenance be done professionally…'

Impacts: The water boilers operate to the satisfaction of the company. The company hardly ever experience problems with the Direct Digital Combustion Control. The company is now able to cut on the cost of its fuel consumption, and minimise the amount of GHGs released in the environment. Other than creating employment for Seychellois

engineers and technicians operating the water boilers, training at local and international levels are also provided so that the technical know-what and know – how of these personnel are continuously up to date. It is to be noted that the company has to seek most of the technical information from its parent company in view that there is a lack of such information locally.

Lesson learnt: The initiative by SEYBREW to install the dual fuel system to its water boilers is a very good example of possible innovation could be carried out locally with the help of both local and international consultants. The company is now enjoying a reduced fuel price but at the same time, minimising the amount of GHGs gasses released in the environment by the installation of the Direct Digital Combustion Control. The example of SEYBREW is a role model that could be followed by other companies that are thinking of making use of water boilers in their industries. The possible trap of resorting solely to economic issue and yet ignoring the possibility of GHGs release in the environment, should be a key factor that must be discouraged at all times.

Case Study 3: The Centre for Industrial, Scientific and Technical Information Documentation (CISTID) *(On Water Boiler)*

Keywords: Centre for Industrial, Scientific and Technical Information Documentation (CISTID), Seychelles Bureau of Standard (SBS), Division of the Centre of Science and Technology, Technical Information, Diesel, Heavy Fuel Oil (HFO).

Summary: The Centre for Industrial, Scientific and Technical Information Documentation (CISTID) is a section of the Division of the Centre for Science and Technology of the Seychelles Bureau of Standards. Set up in 1990 under the joint sponsorship of the Seychelles Government and the Japanese Trust Fund through UNIDO, CISTID raïson d'être is to strengthen the country's industrial, scientific and technical information capability in order to support and promote the country's industrial and economic development. In order to attain its aims, CISTID's main functions are to store, retrieve and disseminate scientific and technical information using computerized systems.

Approach: Having interviewed the key persons for the two case studies illustrated above, the assistance of SBS for technical information needed was raised. As a centre for Industrial, Scientific and Technical Information Documentation, CISTID research and disseminate technical information to clients, based upon their requests. To note in passing, CISTID provide needed information to customers only if they do have them available or if they are retrievable either on the Internet or through international information centres.

However, in view that, for instance, water boilers are patented, then this creates difficulties for them in obtaining specific technical information that would meet the needs of their clients, if there is a need. To this effect, the clients have to contact the technology suppliers, so as to obtain the information needed. With the advent and easily

accessible Internet in Seychelles, a number of clients that used to seek information from CISTID, and now doing their own information mining on the internet themselves. As one of them pointed out, 'the Seychelles Bureau of Standard is quite remote compared to our personnel computer'. Despite the drop in the number of customers, CISTID has built up a database of clients, with specific needs, e.g. water boilers, to which they send information as and when they acquire.

There are a number of clients, including consultancy services, that contact the for Science and Technology Division of SBS to seek for help with purely technical information, with regards to the technology at hand. For instance, if one wants to whether or not HFO could release more GHGs than diesel, to in what quantity, then such technical information could be provided to such customers.

Lesson learnt: The efforts by CISTID to provide clients with information are limited to publicly accessible information. Insofar that this information can be disseminated to clients, from a demand-based based viewpoint, this will continuously help them to take better-informed decision. Besides, insofar that CISTID continue to work in close collaboration with other sections within its division, technical information about GHGs and other technical information that are publicly accessible will continuously be of great help for the clients. It is important to note that CISTID could enhance its capabilities, in further strengthened collaboration with other sections within its division, to provide more information with regards to ways and means that, e.g. innovation could be carried out on water boilers. Cognizant of the strengths and limitations of CISTID, there is a strong need for further information collation with regards to industrial science and technology development in Seychelles. For instance, in view that the issue of water boilers is becoming a key area, enhanced technical information in due respect would further readily available information for customers' uses. In all the efforts, by CISTID is much appreciated by clients but by addressing key areas of contemporary concerns, in collecting information, this would contribute to the priceless services provided by CISTID. This point is being stressed on, in view that, CISTID ought to be the core national organisation in providing information regarding science and technology to the nation. Furthermore, equipped with up to date science and technology information, could also enhance the service provided to customers.

Assessment of technology options for the manufacturing industries

The most direct and relevant aspects of the proposed mitigation options for the manufacturing industries stated in the 'Environment Plan Of Seychelles ' were to:

- Strengthen existing networks and institutions for environment management in the industry;
- Develop a framework for sustainable management for resources;
- Improvement of environment management quality;
- Address industrial environment planning; and,
- Increase transfer of cleaner technology in industry.

Hitherto, the private sector, including Birdlife Seychelles, STAR and SCCI have been taking a leading role, with the support of other governmental institutions, such as Ministry of Education and Youth, Ministry of Transport and Tourism, Ministry of Industries and International Business, and the Seychelles Bureau of Standards, and parastatal organisations such as the Seychelles Marketing Board, to start spearheading the plannification and action plans for improving of the environment management quality in industries. An action plan pertaining to the introduction of ISO 14000 is being devised. The viability of possible pilot projects were being considered by the Ministries and Tourism and Transport and that of Industries and International Business. A number of other activities are being planned to sensitise industries with regards to the benefit of setting up such environmental management systems in place. Furthermore, the issue of cleaner technology transfer has been an almost entire private sector initiative. The government and parastatal organisations have been assisting the private sector with issue pertaining to technical know-how. As to this project, MIIB can grant industries 10% trades tax concessions when importing such technologies, insofar that the capital goods are used for manufacturing purposes.

It is clear that now that there is a technical committee dealing with issues pertaining to industries and environment, the work being undertaken at present will enable a stronger network and institutions for environment management in the industry, further enhance the ongoing debate pertaining to sustainable management of resources, and address the issue of industrial environment planning – an issue which has been dealt with by MIIB recently – which could be further strengthened by the work of the technical committee.

Use of Cleaner Production Technologies In Industries.

The objective of the programme is to increase the use of cleaner technology in industries. Three specific objectives were aimed at, namely:

- To improve access to information on cleaner technology;
- To set up a national cleaner production centre; and,
- To integrate adoption of clean technologies as per the EIA process.

As indicated above this is a project partly being undertaken by a private sector organisation. There seems to be a lack of specific technical information for businesses wanting to innovate their existing technologies.

Key Issues of Stakeholders within the Sector

Users of technologies: The cost of the technology seems to be fine for the users, in view that they are well-established businesses. There is however, a lack of specific technical information that would better enable them to undertake research to further develop the technologies needed.

If a centre for cleaner technologies was established, for instance as a unit within SBS, this would help minimise the problem of access to specific technical information needed.

Besides, such a centre would act as a know-how stimulating centre, for those entrepreneurs looking for ideas as to how they can better adapt their technologies, thus reducing GHGs.

Suppliers of Technologies: Consultancy services dealing with the promotion of cleaner technologies should make more use of the media to raise the public awareness as to what is being done. Such companies should also work in closer collaboration with MIIB, thus seek ways to better the prices of such technologies, despite the fact that clients perceive their prices to be fine.

The Facilitator – MIIB and its Agencies

The MIIB should strongly entice the importation of cleaner technologies, by granting favourable concessionary taxes to the clients. To this effect, as and when the existing industrial policy and science and technology policy is drafted, such issues need to be considered.

SBS should propose the idea of setting up a cleaner production centre for considerations to government. Besides, assistance from international organisations with regards to technical information, need to be asserted. Furthermore, it should take a more leading role in raising public awareness with regards to the issue of option for cleaner production technologies.

Gaps and Weaknesses:

Government: Budgetary constraint limits the procurement of reference books and capital goods for the setting up of a cleaner technology centre. For the time being, Government should further encourage the use of cleaner technologies at project planning and appraisal levels. Besides, the various industrial related policies, such as the industrial policy and the science and technology should incorporate strategies that would encourage the use of cleaner production technologies.

SBS: Should be more in tune with the current needs of the manufacturing sector in terms of cleaner technologies. There is a need to carry out a survey to identify obsolete technologies in use that are contributing the GHGs. Owners of such technologies needs to be advice, so as to either replace adapt them so as to reduce the level of GHGs being emitted.

Private Sector: There is a need for a pressure group from the private sector that would ensure that the various policies put in place are analytically implemented. This group would also help in promoting cleaner technologies nationally. Besides, it would serve as a good interface between the public and the government.

Actions:

With regards to the issue of cleaner industrial technologies, the following actions would need to be taken:

- Government through MIIB needs to incorporate strategies in the various industrial related policies that would reduce the level of GHGs.
- Financial assistance needs to be sought from foreign sources so as to set up a cleaner production technology centre.
- A private sector pressure group needs to be set up to act as an interface between the Government and the general public.
    - It will also assist in information dissemination regarding cleaner technologies to the public.
- SBS needs to further enhance its capabilities to further assist clients with more in depth technical know-how and know-what.

Matrix

Technology	**Socio-Economic Needs**	**Legal Needs**	**Capacity Needs**
Water heaters/ boilers	Further reduce the initial costs of innovation carried out on existing technologies and that of newly imported ones.	Incorporate strategies that would reduce GHGs, in the various technology related policies.	Source finance for the establishment of a cleaner technology centre for public uses.

Key Partnership and Enabling Environment

The key stakeholders from the public, parastatal and public sectors need to further work closer together so as to facilitate the achievements of the various objectives associated with increasing the use of cleaner technologies in industries. There is a need for more fluid information exchange that would enable continuous increases in soft capital vis-à-vis the subject matter.

Incentives need to be provided to entrepreneurs that decide to make use of cleaner production technologies in their manufacturing industries.

Criteria For Effective Technology Transfer

CISTID must beef up it capabilities to deliver more up to date services to the public. The current industrial development trend with regards to the type of cleaner technology transferred must be closely monitored. A private sector pressure group needs to be set up so as to also assist in information dissemination to the general public. Other than the well-established businesses opting for RFO water boilers, SMEs need to be educated regarding it.

Access to Technologies

The current forex shortage limits the procurement of green production technologies. In most cases, a private consultancy organisation act as an intermediary facilitator for the importation of such technologies from abroad.

Administrative Burden

Government should adopt a policy that encourages all industries making use of combustible water boilers to fix a Direct Digital Combustion Control.

Replicability

Almost all the customers making use of water boilers using RFO have no problems with operating the machine. However, if the Direct Digital Combustion Control installed goes

faulty in the first few months after installation, this may create problems in view that it takes time and adequate know-how to recalibrate it.

Long-Term Institutional Capacity Building

There is a need to further train our engineers as to how to set up a Direct Digital Combustion Control Unit on a combustible water boiler. Besides, SBS personnel needs to enhance their capabilities in innovating water boilers and setting up the Direct Digital Combustion Control Unit.

Monitoring and evaluation of continuous delivery of services provided by technology and adequate financial performance

Delivery of services by technology: If maintained properly, combustible water boilers using RFO can reduce the fuel costs by half, compared as to if diesel was used. Continuous and yet little maintenance is needed by it.

Intended and actual: The intended benefits of installing or converting combustible water boilers using RFO is to reduce the cost of fuel. The actual benefit is congruent to such an aim.

Performance of technology: More customers are opting for water boilers using RFO. This indicates that there is an upward trend in this direction.

Quality of benefits: The benefits are seen as favourable by the industries in view that their fuel bill are reduced by half.

Satisfaction of beneficiaries: Owners of established businesses other than the SMEs are satisfied. However, SMEs using water boilers perceive the price of such a technology as unbearable, and even more so, if the Direct Digital Combustion Control Unit is to be installed.

Maintenance and Service of Equipment: Continuous and yet little maintenance is needed for the Combustible Water Boilers. This is not a problem in view that our technicians and engineers are well qualified to perform these tasks. However, despite that fact that Direct Digital Combustion Control Unit hardly ever need maintenance, there is a need for at least two well trained engineers to oversee that the this unit is maintained properly.

Payback Period: The well-established businesses have no problem with the pay back period, in view that they make cash down payment in procuring the technologies in question. However, this is otherwise for the SMEs who have to take loans from Credit lines or Commercial Banks.

A Stakeholders Typology

Sources and Developers of Technology

There are some in-house R&D activities with regards to converting diesel system fuel line into HFO. However, the issue of reducing the GHGs has been an afterthought.

Owners and Suppliers of Technology
Company mainly based in Germany and Mauritius supplies the water boilers as per the demand of the recipients. Again no effort was being paid to the issue of reducing GHGs.

Buyers of Technology
SOTRATECH LIMITÉE, SEYBREW, SMB, and other five star hotels around the islands are the buyers of such technology. It is worthwhile to note that the issue of cost reduction in fuel price superseded reduction in GHGs.

Financiers of Technology Transfer
Credit lines such as YES scheme, EU-line of credit; Commercial Banks such as Barclays Bank, Nouveau Bank, Banque Francais Commercial, and Development Bank of Seychelles, etc… are the main financiers for technology transfer. To a lesser extend, individual organisations directly finance their technology.

Information Providers
SOTRATECH LIMITÉE, SBS and CISTID, international vendors, parent companies of the technology are the providers of information to the clients.

Market Intermediaries
SOTRATECH LIMITÉE is the main market intermediary organisation at present.

Government
Government through MIIB provides trades tax concessions for such technology, insofar that they are directly used in the manufacturing processes. Again there is no distinction in the trades tax rates to encourage GHGs reducing technologies.