Technology Fact Sheet for Adaptation

Protecting refugia which are less vulnerable to climatic changes [i]

1. SECTOR: *To be written by sector expert*	Biodiversity
TECHNOLOGY CHARACTERISTICS	
2.1 Technology name:	Protecting refugia which are less vulnerable to climatic changes
2.2 Introduction: *Low/high, Brief introduction to the technology*	Refugia are areas where climate-change impacts are predicted to be less severe[1]. Plant ecologists and paleoecologistsrecognise that some environments are more buffered against climate change and short-term disturbances than others[2]. Such sites will be vital areas that can be used to conserve biodiversity in a changing climate. There will be refugia already present that may not be conserved or given its due level of legal protection. It is of utmost importance to identify such areas and ensure that these areas are adequately protected. This is considered to be a low-medium level technology. *Reference in existing policies, strategies and action plans:* The Biodiversity Conservation - Framework for Action, in the section on in-situ conservation, recommends to 'Identify critically important biodiversity hotspots in the country outside forests and bring them under a relevant protected area category'[3]. The Climate Change Adaptation Strategy[4] for Sri Lanka and the Sector Vulnerability Profile for Biodiversity and Ecosystem Services[5] has identified to 'Link/restore/conserve, forests and other habitat refugia to increase resilience of ecosystems and species' - (B i) and to 'Establish and/or effectively manage PAs and other important wildlife

[1]Mawdsley, J.R., O'Malley, R., Ojima, D.S., 2009. A review of climate-change adaptation strategies for wildlife management and biodiversity conservation. Conservation Biology 23, 1080–1089.

[2] Millar, C.I., Stephenson, N.L., Stephens, S.L., 2007. Climate change and forests of the future: managing in the face of uncertainty. Ecological Applications 17, 2145–2151.

[3]Ministry of Environment and Natural Resources. 2007. Biodiversity Conservation in Sri Lanka: A Framework for Action – Addendum.

[4]Ministry of Environment. 2010. National Climate Change Adaptation Strategy for Sri Lanka 2011 to 2016.

[5]Ministry of Environment. 2010. Sector Vulnerability Profile: Biodiversity and Ecosystem Services.

	refuges in all climatic zones' - (B iv).
2.3 Technology characteristics/highlights: *Few bullet points, ie. Low/high cost, advance technology; low technology*	This is a low-medium technology as such sites are already present, and the main activity would be to identify suitable areas and protect them. It could involve rating known refugia that have a potential for homeostasis by being situated in favorable areas, followed by legal protection. It may require some management and intervention, but may not require a large investment if the ecosystems are intact. However in some cases restoration maybe requires which could be quite costly. Monitoring and minimizing other threats will also be vital components for its survival. Biological details relating to refugia[6]: Refugial areas are often rich in species, genomes, and alleles. These distinct intraspecific genomes have evolved different genetic adaptation so their potential for future change may vary. Some refugial areas, where genomes survive and diverge over several major oscillations, are likely to allow speciation and accumulation of diversity. These rich areas appear to be those that can sustain populations throughout the climatic fluctuation, rather than just extremes. Mountainous and tropical areas appear to be particularly successful. According to research, divergence and speciation seem to accumulate in refugia.
2.4 Institutional and organizational requirements: *How much additional capacity building and knowledge transfer is required for the adaptation option to be implemented.*	There will be some capacity building and knowledge transfer required to identify sites as research will need to be done at a fine scale to identify refugia, which have stable climates. This may require some field study, fine scale climatic data and climate change modeling. Once identified, establishing it will not be considered a new technology, as it will be very similar to creating a new protected area. Monitoring will be necessary.

[6] Hewitt, G.M., and Nichols, R. A. 2005. Chapter 12 – Genetic and Evolutionary Impacts of Climate Change. In: Lovejoy T, Hannah L, eds. 2005. In Climate Change and Biodiversity. New Haven, CT: Yale Univ. Press

3. OPERATIONS AND MAINTENANCE	
3.1 Endorsement by experts:	For details of endorsement by local experts and relevant agencies see section on *'Reference in existing policies, strategies and action plans'* in Section 2.1. Experts have endorsed the concept of protecting refugia as important areas for conserving biodiversity in a changing climate. These views have been expressed in international peer reviewed journals[7,8].
3.2 Adequacy for current climate: *Are there negative consequences of the adaptation option in the current climate? Some adaptation may be targeted at the future climate but may have costs and consequences under the current climate.*	Refugia by definition will have stable climates and protecting such an area will not have negative consequences in the current climate. Refugia will have similar benefits to protected areas.
3.3 Size of beneficiaries group: *Technology that provides small benefits to large number of people will be favored over those that provide larger benefits, but to fewer people.*	The main benefits would be from ecosystems services, which for example could be watershed functions, regulating microclimate. It will thus benefit a larger group. There could be some benefits to local communities from community conservation initiatives, REDD, payment for ecosystem services etc.
4. COSTS	
4.1 Cost to implement adaptation options: *Cost measures*	There will be low-medium costs associated with this technology as most costs would be to protect and monitor the site, after the initial research and site selection has been carried out. It is estimated that this activity will cost Rs. 85 million annually. This is based on the assumption that a budget increase of 4.25% of current conservation budgets will be necessary for this activity (based on total Forest Department and Wildlife Department annual budgets). It is estimated that 25% of this will be borne by the public sector.

[7]Mawdsley et al, 2009. Op. Cit.

[8]Noss, R. F. 2001. Beyond Kyoto: forest management in a time of rapid climate change. Conservation Biology 15:578–590.

	This activity will need to be carried out until most prioritized sites are covered, and will have to be an annual budget. Cost will be for site selection (with use of models and available information), prioritization, establishment (legal declaration, acquisition of land if necessary) and monitoring.
4.2 Additional costs to implement adaptation option, compared to "business as usual"	The additional cost will be rather low as it would mainly be conservation and monitoring related activities. There could be some costs relating to alternative jobs, resettlement if people need to be resettled or in extractive activities need to be stopped.
5. DEVELOPMENT IMPACTS, INDIRECT BENEFITS	
5.1 Economic benefits: **Employment** - *Jobs* **Investment** - *Capital requirements*	**Employment:** • There could be some direct benefits from the establishment, conservation and monitoring of the refugia. • Refugia could be highly protected sites and there could be some job opportunities from very low impact ecotourism. **Investment:** • The main investment would be to obtain and legalize the area as a protected site. • There might be investment necessary for monitoring vehicles and equipment.
5.2 Social benefits: **Income** – *Income generation and distribution* **Education** – *Time available for education* **Health** – *Number of people with different diseases*	**Income:** • Jobs could be created during the establishment for conservation and monitoring related activities. • There could be some income generation from community conservation, ecotourism, REDD and payment for ecosystem services. **Education:** • Student will have an opportunity to study unique refugia and how they can be used to conserve biodiversity in a changing climate. • University students can carry out advanced research, and even contribute to better conservation techniques. **Health:** • Ecosystem services will provide health benefits, especially through

	water, microclimate regulation, disease control etc. • Good environmental condition will also contribute to general well being.
5.3 Environmental benefits: *Reductions in GHG emissions, local pollutants, ecosystem degradation etc.*	The main benefits would be the provision of a stable climate and habitat for biodiversity conservation in a changing climate to ensure its viability. There will be a multitude of environmental benefits associated with ecosystem services. These include carbon sequestration, maintaining biodiversity, regulating the microclimate etc. If refugia from all climatic zones can be identified, and protected – persisting populations may be able to recolonize when conditions become more favorable[9].
6. LOCAL CONTEXT	
6.1 Opportunities and barriers: *Barriers to implementation and issues such as the need to adjust other policies*	**Opportunities:** • There are legal and policy provisions to create such areas as they take the same approach as creating protected areas. **Barriers:** • The challenge would be to identify and select such areas. • Minimizing external threats and extractive use. • May require land acquisition, payment of compensation and resettlement.
6.2 Status: *Status of technology in the country*	This technology will be similar to the creation of protected areas, and is not a new technology. However at the beginning it will require climate change modeling for biodiversity, which can be considered to be a relatively new technology in the country.
6.3 Timeframe: *Specify timeframe for implementation*	It could take a few months, to a year. Continuous monitoring will be necessary.
6.4 Acceptability to local	It is possible that refugia may be protected under a high protection

[9]Noss, R. F. 2001. Beyond Kyoto: forest management in a time of rapid climate change. Conservation Biology 15:578–590.

stakeholders: *Whether the technology will be attractive to stakeholders*	category and may restrict use. This may not be acceptable to direct beneficiaries although they could benefits form community conservation, REDD, payments for ecosystems services etc. Identifying a refugia, which is not vulnerable to climatic changes and with an opportunity to contribute to biodiversity adaptation could be considered to be a pride and recognition for local communities and thus be attractive.

[i] **This fact sheet has been extracted from TNA Report – Technology Needs Assessment Reports For Climate Change Adaptation – Sir Lanka. You can access the complete report from the TNA project website http://tech-action.org/**