PROJECT IDENTIFICATION FORM (PIF)

UNEP/GEF WORKING TEMPLATE
PROJECT TYPE: **Full-sized Project**
TYPE OF TRUST FUND: **LDCF**

PART I: PROJECT INFORMATION

Project Title:	Building climate resilience of urban systems through Ecosystem-based Adaptation (EbA) in the Asia-Pacific region.		
Country(ies):	Bhutan, Cambodia, Lao PDR, Myanmar	**GEF Project ID:**	
GEF Agency(ies):	UNEP	**GEF Agency Project ID:**	01278
Other Executing Partner(s):	UNEP – Regional Office for Asia Pacific (ROAP) and UN-HABITAT.	**Submission Date:**	16 April, 2014
GEF Focal Area (s):	Climate Change Adaptation	**Project Duration(Months)**	48 months
Name of parent programme (if applicable):		**Agency Fee (US$):**	570,000

A. INDICATIVE FOCAL AREA STRATEGY FRAMEWORK:

Focal Area Objectives	*Trust Fund*	*Indicative Grant Financing ($)*	*Indicative Co-financing ($)*
CCA-1 (Component 2)	LDCF	4,700,000	6,725,000
CCA-2 (Component 1 and 3)	LDCF	1,300,000	1,975,000
Total project costs		6,000,000	8,700,000

B. INDICATIVE PROJECT FRAMEWORK

Project Objective: To reduce the vulnerability of poor urban communities in Asia-Pacific LDCs to climate change impacts through the application of Ecosystem-based Adaptation (EbA).

Project Component	Grant Type	Expected Outcomes	Expected Outputs	Trust Fund	Indicative Grant Amount ($)	Indicative Co-financing ($)
1. Institutional strengthening and capacity building of city management authorities in pilot cities to plan and implement urban EbA.	TA	1.1 Technical and institutional capacity of city management authorities to integrate urban EbA into development planning strengthened.	1.1.1 Collation, review and synthesis of knowledge on adaptation to climate change in an urban context to guide interventions in pilot cities. 1.1.2 City management authorities in pilot cities trained on climate change impacts and appropriate urban EbA interventions. 1.1.3 Decision-making tools that integrate urban EbA into development city planning. 1.1.4 Strategy to upscale and sustain EbA interventions through strengthening of local financial mechanisms to fund EbA actions.	LDCF	871,486	826,500

2. Demonstrating urban EbA interventions in pilot cities.	INV	2.1 Vulnerability of poor urban communities to climate change impacts in pilot cities reduced.	2.1.1 Assessment of city-specific climate change impacts and adaptation needs through a multi-stakeholder engagement process and cost-benefit analysis. 2.1.2 Protocols for city-specific implementation of urban EbA interventions, developed in consultation with relevant stakeholders 2.1.3 City-specific urban EbA interventions appropriate to the social, cultural and environmental contexts – including urban reforestation, urban agriculture and wetland restoration – in pilot cities. 2.1.4 Alternative livelihoods based on the benefits of city-specific urban EbA interventions to reduce the climate vulnerability of poor urban communities. 2.1.5 Long-term research programmes in scientific institutions to assess the long-term societal, economic and ecological benefits of urban EbA in pilot cities.	LDCF	4,286,143	6,198,750
3. Disseminating knowledge and raising public awareness on urban EbA in pilot cities.	TA	3.1 Knowledge base for supporting the design of urban EbA interventions strengthened, and public awareness of the positive potential of urban EbA interventions to reduce vulnerability to climate change impacts increased.	3.1.1 Assessment of the performance of urban EbA interventions and lessons learnt in pilot sites shared nationally and regionally. 3.1.2 Knowledge on integrating urban EbA into city planning and management processes available on local, national and regional platforms to facilitate the upscaling of urban EbA approaches throughout the region. 3.1.3 Public awareness and training programmes on climate change impacts and appropriate urban EbA interventions.	LDCF	557,229	1,239,750
Sub-Total					5,714,858	8,265,000
Project management cost (PMC)					285,142	435,000
			Total project costs		6,000,000	8,700,000

C. INDICATIVE CO-FINANCING FOR THE PROJECT BY SOURCE AND BY NAME IF AVAILABLE, ($)

Sources of Co-financing	Name of Co-financier	Type of Co-financing	Amount ($)
Multilateral Agency	United Nations Human Settlement Programme (UN-HABITAT)	Grant	4,000,000

GEF Agency – UN HABITAT	United Nations Development Programme (UNDP)/United Nations Environment Programme (UNEP) Poverty Environment Initiative (PEI)	Grant	4,000,000
GEF Agencies – UNEP-UNDP -PEI	United Nations Environment Programme (UNEP) – Ecosystem-based Adaptation Flagship Programme	Grant	500,000
GEF Agency – UNEP	United Nations Environment Programme (UNEP) – Urban Ecosystem-based Adaptation project	Grant	200,000
Total Co-financing			8,700,000

D. INDICATIVE TRUST FUND RESOURCES ($) REQUESTED BY AGENCY, FOCAL AREA AND COUNTRY

GEF Agency	Type of Trust Fund	Focal area	Country Name/Global	Grant amount ($) (a)	Agency Fee ($) (b)	Total ($) (a+b)
UNEP	LDCF	Climate Change	Bhutan	1,500,000	142,500	1,642,500
UNEP	LDCF	Climate Change	Cambodia	1,500,000	142,500	1,642,500
UNEP	LDCF	Climate Change	Lao PDR	1,500,000	142,500	1,642,500
UNEP	LDCF	Climate Change	Myanmar	1,500,000	142,500	1,642,500
Total Grant Resources				6,000,000	570,000	6,570,000

E. PROJECT PREPARATION GRANT (PPG)

	Amount Requested ($)	Agency Fee for PPG ($)
• No PPG required		
• (up to) $50k for projects up to and including $1 million		
• (up to) $100k for projects up to and including $3 million		
• (up to) $150k for projects up to and including $6 million	150,000	14,250
• (up to) $200k for projects up to and including $10 million		
• (up to) $300k for projects above $10 million		

PPG AMOUNT REQUESTED BY AGENCY(IES), FOCAL AREA(S) AND COUNTRY(IES) FOR MFA AND/OR MTF PROJECT ONLY

GEF Agency	Type of Trust Fund	Focal area	Country Name/Global	(in $)		
				PPG (a)	Agency Fee(b)	Total c = a + b
UNEP	LDCF	Climate change	Bhutan	37,500	3,562	41,062
UNEP	LDCF	Climate change	Cambodia	37,500	3,563	41,063
UNEP	LDCF	Climate change	Lao PDR	37,500	3,562	41,062
UNEP	LDCF	Climate change	Myanmar	37,500	3,563	41,063
Total PPG Amount				150,000	14,250	164,250

MFA: Multi-focal area projects; Multi-Trust Fund projects.

PART II: PROJECT JUSTIFICATION

A. PROJECT OVERVIEW

A.1.1. The project problem, root causes and barriers that need to be addressed

The Asia-Pacific region spans the eastern Indian to the south-western Pacific oceans, and includes Southeast and much of East Asia. The region is currently experiencing rapid urbanisation, with urban populations increasing at an average rate of 2% per year[1]. Bhutan (3.7%), Cambodia (3.2%), Lao PDR (4.9%) and Myanmar (2.9%)[2] – all Least Developed Countries (LDCs) in the Asia-Pacific – exceed this average. Urban populations that are rapidly expanding in these LDCs are negatively impacting on the ecosystems associated with cities.

In Asia-Pacific, ecosystems surrounding and within urban areas provide a range of important services that support urban communities. These services include the provision of natural resources (e.g. food, fuelwood and high quality drinking water) and regulatory functions (e.g. flood mitigation, water filtration, micro-climate regulation and waste decomposition). Furthermore, ecosystems within urban areas – including wetlands, green spaces, agricultural land, coastal areas and woodlands – provide protective, recreational, and cultural benefits while improving the aesthetics of cities. Ecosystem services also improve human living conditions and livelihoods and maintain biodiversity in urban/peri-urban areas. The recent urban expansion in the Asia-Pacific has been detrimental to such ecosystem services, because the construction of urban infrastructure: i) replaces natural ecosystems; ii) leads to increased pollution; and iii) decreases biodiversity.

The urban poor and marginalized communities in Asia-Pacific countries of Bhutan, Cambodia, Lao PDR and Myanmar are particularly reliant on ecosystem services. This is because these communities often lack access to basic services, such as clean water, sanitation and electricity. For example, of the urban population in Bhutan, 16% do not have access to safe drinking water, 11% do not have access to toilets, and 40% do not use electricity as their main source of lighting[3]. Inadequate infrastructure, limited resources and poverty further compound this problem. The percentage of the population who live below the poverty line in these countries ranges from 20% in Cambodia to 33% in Myanmar[4]. Vulnerable urban communities often live in slums, many of which are situated in marginal areas that are vulnerable to natural hazards. Goods and services provided by functioning ecosystems can provide poor urban communities with important livelihood options to cope with economic stresses and buffer them against natural hazards. Consequently, environmental degradation associated with urbanization is increasing the vulnerability of these poor urban communities.

Current climate variability and change is further exacerbating the above-mentioned environmental stresses and associated vulnerabilities. There is evidence of increased intensity and/or frequency of extreme weather events, including heat waves, tropical cyclones, prolonged dry spells, intense rainfall, thunderstorms, and severe dust storms in the region. For example, Cyclone Nargis hit Myanmar in 2008 causing approximately 130,000 deaths and US$ 4.1 billion in damages[5]. Furthermore, increases in intense rainfall events throughout the region have resulted in severe floods, landslides and mudflows. In Cambodia, severe floods in 2011 resulted in 250 deaths, while floods that occurred between 2000 and 2002 resulted in 438 deaths and caused damages amounting to US$ 205 million[6]. Similarly, in Lao PDR, flooding associated with Storm Lekima in 2007 affected six provinces and caused approximately US$ 2 million damage to irrigation infrastructure[7]. Impacts from these extreme weather events on poor urban communities include disease, starvation, and loss of livelihoods and income[8, 9] (See Appendix A for a summary of observed climate change trends and impacts in the Asia-Pacific region).

[1] UNESCAP. 2011. Statistical yearbook for Asia and the Pacific [available from: http://www.unescap.org/stat/data/syb2011/I-People/Population.asp]
[2] The World Factbook. Available from: https://www.cia.gov/library/publications/the-world-factbook/geos/cb.html
[3] Royal Government of Bhutan, Ministry of Works and Human Settlement, 2008. Thimphu City Development Strategy.
[4] http://data.worldbank.org/topic/urban-development.
[5] Tripartite Core Group. 2009.Post Nargis Joint Assessment (PONJA) "Post Nargis Periodic Review II".
[6] Kingdom of Cambodia National Adaptation Programme of Action to Climate Change 2006.
[7] Lao People's Democratic Republic National Adaptation Programme of Action to Climate Change 2009.
[8] UNFCCC Climate Change: Impacts, Vulnerabilities & Adaptation in Developing Countries
[9] Cruz, R.V., H. Harasawa, M. Lal, S. Wu, Y. Anokhin, B. Punsalmaa, Y. Honda, M. Jafari, C. Li and N. HuuNinh, 2007. Asia. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 469-506.

Predicted climate change, including variable rainfall patterns, higher temperatures, and sea-level rise, will further negatively affect vulnerable urban communities in the Asia Pacific, as well as the ecosystems upon which they depend. Urban areas in Bhutan, Cambodia, Lao PDR and Myanmar are all susceptible to the predicted negative impacts of climate change. The capital city of Bhutan (Thimphu), for example, is considered to be one of the 15 cities in the world most vulnerable to climate change[10]. All four countries are expected to experience an increase in the frequency and intensity of extreme weather events, notably flooding and droughts. Furthermore, average annual temperatures have been increasing in all four countries, which will compound the heat island effect in urban areas leading to increased heat stress. An increase in the intensity and frequency of cyclones/strong winds is predicted for Myanmar, while landslides are predicted to increase in frequency in Bhutan[11]. All of these climate change impacts will negatively affect urban communities, resulting in: i) decreased food security; ii) decreased water security; iii) inadequate sanitary conditions; iv) increased health risks and spread of diseases such as dengue, typhoid and cholera; v) loss of life, assets and livelihood options; vi) increased uncontrolled migration; and vii) reduced energy supplies. Consequently, there is an urgent need to implement adaptation interventions to reduce the negative impacts of climate change on vulnerable urban communities in the Asia-Pacific region.

The **problem** that the proposed LDCF project seeks to address is that underprivileged urban communities living in Asia-Pacific LDCs are vulnerable to current and predicted climate change impacts including flooding, droughts, landslides, cyclones and increased temperatures. Local city management authorities have limited capacity, knowledge or financial resources to manage these climate change impacts. There is consequently an urgent need to identify, demonstrate, maintain and upscale adaptation interventions, as well as to build capacity and knowledge of governments, city-management authorities and community members, to increase the climate change resilience of poor urban communities living in Asia-Pacific LDCs.

The **proposed response** is to build the climate resilience of vulnerable urban communities living in Asia-Pacific LDCs by catalysing large-scale implementation of Ecosystem-based Adaptation (EbA) in the urban context, given its effectiveness and multiple benefits it provides. This will be achieved by demonstrating urban EbA interventions in pilot cities in Bhutan, Cambodia, Lao PDR and Myanmar. Subsequently, knowledge on the design and implementation of urban EbA will be disseminated throughout the region. City-management authorities and local communities in pilot cities will also be trained on climate change and EbA. Furthermore, an upscaling strategy will be developed to promote urban EbA approaches in other cities both nationally and regionally.

EbA reduces climate change vulnerability while providing multiple benefits to society and the environment by protecting, maintaining and rehabilitating ecosystems[12]. This approach is effective in both rural and urban settings. Examples of urban EbA interventions include: i) *urban reforestation*, which limits urban heat-island effects, mitigates flooding and enhances groundwater recharge through planting a range of climate-resilient and preferably multi-benefit tree[13] species; ii) *wetland restoration* within urban areas, which assists communities adapt to climate-related threats such as decreased water quality and supply, flooding and erosion, and enhances food security by maintaining the breeding habitats of fish and other aquatic organisms; and iii) *urban agriculture*, which builds the climate resilience of the urban poor by diversifying urban food sources and income streams through livestock production and propagation of multi-use plants and trees in urban areas. Importantly, urban EbA has been shown to require comparatively small investments relative to the long-term social, economic and environmental benefits. It has been found that while the price of land, labour and water for urban agriculture is greater than rural agriculture, the costs of commercial inputs is lower and that urban agriculture benefits from the proximity to markets[14]. In addition, a study in Lami Town, Fiji supported by UNEP in collaboration with other partners found that EbA

[10] Fellows of the Capacity Strengthening in the Least Developed Countries for Adaptation to Climate Change (CLACC), 2009. Climate change and the urban poor: Risk and resilience in 15 of the world's most vulnerable cities.
[11] Bajracharya, S.R., Mool, P.K., & Shrestha, B.R. 2007. Impact of climate change on Himalayan glaciers and glacial lakes: case studies on GLOF and associated hazards in Nepal and Bhutan. International Centre for Integrated Mountain Development (ICIMOD), Kathmandu.
[12] Jones, H.P., D. G. Hole & E. S. Zavaleta. 2012. Harnessing nature to help people adapt to climate change. Nature Climate Change 2: 504-509
[13] Certain tree species can provide additional benefits to human populations through the provision of non-timber forest products (NTFPs). This can include nuts, seeds, berries, medicinal plants, fuelwood, fodder and construction materials.
[14] FAO 2007. The state of food and agriculture.

options provide a high benefit-to-cost return in terms of avoided flood damages as well as provision of secondary ecosystem services[15]. Overall, EbA provides a low-cost and effective approach for building the climate resilience of the poor urban communities.

Significant barriers to achieving the implementation of urban EbA exist in the Asia-Pacific region. These barriers include: i) insufficient local evidence to demonstrate the benefits of EbA in urban areas to national and local policy- and decision-makers; ii) limited local urban community understanding of the benefits of EbA, as a result of limited on-the-ground examples; iii) limited knowledge and financial resources to incorporate urban EbA into national/local development plans; and iv) insufficient institutional capacity to coordinate the implementation and upscaling of urban EbA interventions.

The proposed LDCF project will contribute to overcoming the above adaptation barriers by: i) demonstrating urban EbA interventions – including urban reforestation, urban wetland restoration and urban agriculture – in four pilot cities; ii) collecting and disseminating knowledge for supporting the design of urban EbA interventions; iii) raising public awareness of the impacts of climate change and the benefits of urban EbA; and iv) strengthening the technical and institutional capacity of city management authorities to plan, implement and upscale urban EbA.

A.1.2. The baseline scenario and associated baseline projects

Urban communities in Bhutan, Cambodia, Lao PDR and Myanmar are negatively affected by climate change impacts. In addition, climate change – including floods and droughts – is decreasing agricultural productivity in rural areas. Decreased agricultural productivity results in reduced food security and job losses, which compels rural people to migrate to urban areas. Climate change is therefore enhancing the already rapid trend of urbanisation and its associated economic, social and environmental problems. Rapid urbanisation has led to an increase in urban poverty and limited access to basic services in many cities. Ensuring food and water security, managing disaster risks, protecting infrastructure, and improving the livelihoods of the urban poor are major challenges for urban areas in the Asia-Pacific. These baseline problems are being addressed by a number of regional baseline projects, further described below. As the pilot cities have not yet been identified and will be identified during the PPG through a thorough participatory selection process, baseline projects will be further updated with city-specific baseline projects, identified during the PPG phase.

UN-Habitat Water for Asian Cities (WAC) Programme. The WAC programme operates in several Asian countries, including Cambodia and Lao PDR. The WAC Programme was initiated in 2003 and has an initial budget of US$ 10 million funded by the Asian Development Bank (ADB). The programme aims to improve efficiency of water use, scale-up city-wide sanitation provision, and develop new pro-poor investments in urban water supply and sanitation. The programme seeks to achieve this by mobilizing political will, raising awareness, capacity building, and promoting new investments in the urban water and sanitation sector. In Cambodia, the WAC programme – in collaboration with the Cooperation for a Sustainable Cambodian Society – has implemented the Human Values-based Water, Sanitation and Hygiene Education (HVWSHE) pilot project in Phnom Penh. Furthermore, the WAC programme has provided community-based water supply services for communities in 12 villages in Praek Thmei Commune in Cambodia (budget of ~US$ 40,000), with further investments (~US$ 30,000) planned for the Praek Thmei and Praek Sdei Commune. To date, ten projects in Lao PDR have been implemented under WAC (totalling ~ US$ 2 million), six of which have been completed. The projects in Lao PDR include: i) developing a baseline database in water and environmental sanitation indicators; ii) developing pilot demonstration on biogas digesters; iii) hygiene promotion; iv) gender mainstreaming; v) raising awareness and capacity on community waste management; vi) water supply and sanitation for Northern and Central regions; and vii) water conservation and management.

The WAC Programme is vulnerable to climate change impacts such as flooding and landslides, which can damage water supply infrastructure and thereby increase the spread of water-borne diseases. The proposed LDCF project will 'climate-proof' the WAC programme by integrating urban EbA into its water and sanitation provision projects

[15] UNEP/STREP 2012. A comparative analysis of ecosystem-based adaptation and engineering options for Lami Town, Fiji: Synthesis Report.

and investments. Urban EbA interventions such as wetland rehabilitation and urban reforestation will be implemented to increase the climate resilience of water resources (quality and quantity) and improve sanitation conditions within pilot cities. This will support the WAC programme in meeting its urban water supply and sanitation goals.

UN-Habitat Mekong Region Water and Sanitation Initiative (MEK-WATSAN). A sub-programme of the larger WAC programme, the goal of the MEK-WATSAN initiative is to improve the living conditions of the urban poor in the Mekong region by providing the inhabitants with improved access to water supply and adequate sanitation services. The initiative is a collaborative effort between UN-HABITAT and the governments of the Mekong region, including Cambodia and Lao PDR, and is being implemented in partnership with the ADB. In Lao PDR, the initiative has implemented 19 water and sanitation-related projects in eight different provinces with a total budget of ~ US$ 6.5 million. These projects in Lao PDR have included: i) adaptation of the International Guideline on Decentralization and access to basic services (US$ 70,000); ii) enhancing pro-poor water governance in Lao PDR with DHUP (US$ 160,000); and iii) establishment of a water supply system and improved access to sanitation services in Atsaphangthong District, Savannakhet (US$ 800,000). The MEK-WATSAN initiative has also implemented projects in Cambodia. These projects have included improving sanitation infrastructure in three towns in Cambodia, namely Pursat, Kampong Cham and Svay Rieng. The total investment by the initiative in Cambodia thus far is ~ US$ 2.5 million.

Climate change impacts are expected to negatively affect the activities of the MEK-WATSAN initiative in several ways. Firstly, water supply infrastructure constructed through the initiative may be damaged by floods, cyclones, severe storms, mudslides and landslides. Secondly, an increased incidence and severity of droughts and increased temperatures are likely to reduce water availability and quality, negatively affecting the ability of the initiative to supply clean drinking water. Finally, heavy rains and increased heat stress will increase the incidence of pests – such as mosquitoes – and diseases, reducing the effectiveness of sanitation projects. These climate change impacts will limit the ability of the MEK-WATSAN initiative to achieve its objectives of improved access to water and adequate sanitation. The proposed LDCF project will integrate urban EbA interventions into the current water and sanitation provision activities of the MEK-WATSAN initiative. Urban EbA interventions, such as urban reforestation and urban wetland rehabilitation, will increase water availability, decrease heat stress and mitigate flooding. Integrating these urban EbA interventions into MEK-WATSAN activities will therefore reduce the negative effects of climate change on the initiative.

UNDP-UNEP Poverty-Environment Initiative (PEI). The PEI is a global initiative that seeks to mainstream poverty-environment linkages into national development planning. The PEI in Lao PDR focuses on ensuring that the country's rapid economic growth and flow of foreign direct investment into the natural resource sectors generates sustainable and inclusive development. The main activities under this project are: i) implementing elements of the 7th National Socio-Economic Development Plan; ii) improving the capacity of national and provincial authorities to plan and manage private investment for pro-poor, pro-environment outcomes; iii) supporting the implementation of the Environmental and Social Impact Assessment Decree; and iv) developing capacity for research and analysis of the economic value of ecosystem services. The PEI in Lao PDR will continue until the end of 2015 and is implemented in partnership with the Ministry of Planning and Investment. The total budget of this project is ~US$ 4.2 million funded by the Swiss Development Cooperation (US$ 3 million), PEI (US$ 0.69 million) and UNDP (US$ 0.5 million). In PEI Bhutan, the focus is on sustainable development planning and implementation at national and local levels. The main activities of PEI Bhutan are: i) developing environment-climate-poverty mainstreaming guidelines, tools, indicators and communication materials; ii) integrating environment-climate-poverty linkages into national and local development plans; and iii) developing a green accounting system. This project has a total budget of ~US$ 5 million funded by the Government of Denmark (US$ 3.27 million), PEI (US$ 0.75 million), UNCDF (US$ 0.56 million) and UNDP (US$ 0.11 million). PEI Bhutan is being implemented in partnership with the Gross National Happiness Commission with Phase III starting in January 2013 and ending 2017.

Climate change impacts – including floods, heavy rains, storms, and cyclones – damage infrastructure and pose a major threat to sustainable development. In this way, climate change will decrease the ability of the PEI to achieve its development and poverty reduction objectives. The proposed LDCF project will build upon current PEI projects

by incorporating climate change adaptation, and in particular EbA strategies, into their urban sustainable development goals. Furthermore, the proposed LDCF project will build capacity and share knowledge of climate change and EbA through the PEI's existing network of national and regional stakeholders.

A.1.3. The proposed alternative scenario

The proposed LDCF project will increase the climate resilience of poor urban communities living in Asia-Pacific LDCs by complementing the existing activities of the relevant baseline projects with urban EbA interventions. These urban EbA interventions will include urban reforestation, urban wetland restoration and urban agriculture. Furthermore, the proposed LDCF project will support the large-scale application of EbA by collating and disseminating scientific knowledge on urban EbA and lessons learned during project implementation to national and local authorities.

The proposed LDCF project will be implemented in four Asia-Pacific LDCs, namely i) Bhutan; ii) Cambodia; iii) Lao PDR; and iv) Myanmar. These countries are expected to face similar climate change threats, including increased incidence and severity of flooding, droughts, erratic rainfall and heat stress. This similarity of threats will facilitate the transfer of EbA technologies as well as lessons learned between the selected countries. Urban EbA interventions will be implemented in one pilot city per country, preferably with a population size[16] of less than 2.5 million. Pilot cities will be selected based on criteria which include *inter alia*: i) vulnerability to current and future climate change threats, ii) climate change vulnerability of the urban population (with reference to poverty levels and population density); iii) availability of relevant city-specific baseline projects; and iv) willingness of local authorities to implement urban EbA. The criteria list will be reviewed during the PPG, at its inception phase. Potential candidate cities for the proposed LDCF project include Thimphu (Bhutan), Siem Reap, Sinanoukville and Kampot (Cambodia), Oudoxmay and Pakse (Lao PDR), and Mandalay and Naypyidaw (Myanmar).

The above will be achieved by delivering three integrated and complementary components.

Component 1: Institutional strengthening and capacity building of city management authorities in pilot cities to plan and implement urban EbA

This component will strengthen the technical and institutional capacity of city management authorities in pilot cities to plan and implement urban EbA. Within this component, the proposed LDCF project will:

- collate, review and synthesise knowledge of effective adaptation to climate change in an urban context – including urban EbA and other relevant hard adaptation interventions – to guide interventions in pilot cities;
- build or strengthen an EbA focus within local government institutions and city management authorities;
- develop a framework to strengthen collaboration between local, provincial and national government/institutions responsible for large scale ecosystem management;
- train city management authorities in pilot cities on climate change impacts and appropriate urban EbA interventions;
- develop policy briefs, technical guidelines and toolkits on increasing the resilience of vulnerable urban community livelihoods to climate change using appropriate urban EbA interventions such as urban reforestation, urban wetland restoration and urban agriculture; and
- develop decision-making tools to integrate EbA into urban development planning.
- develop national upscaling strategies – with relevant local and national government departments – to promote urban EbA approaches and incorporate them into national development policies, strategies and legislation, including a local finance mechanism to fund EbA actions

The knowledge base developed within Component 1 of the proposed LDCF project will be used for designing urban EbA interventions in the four pilot cities within Component 2. The training provided to city management authorities will enable them to design and implement further urban EbA interventions both within and outside of the four pilot cities.

[16]Because of the limited financial resources available for such a project, the population size of the targeted cities will not be more than 2.5 million. This will enable the project to generate tangible results and benefits and therefore secure buy-in from the respective city municipalities and mayors.

Component 2: Demonstrating urban EbA interventions in pilot cities

This component will increase the resilience of vulnerable urban communities to climate change impacts in pilot cities through the implementation of urban EbA interventions. An assessment of climate change impacts and adaptation needs in each pilot city will guide the selection of appropriate urban EbA interventions such as urban reforestation, urban wetland restoration and urban agriculture. These interventions will be: i) city-specific; ii) cost-effective; and iii) environmentally and socially sustainable. Where possible, the proposed LDCF project will build on and strengthen existing city and national EbA interventions identified in the PPG phase as well as on local community knowledge to build on good practice and ensure lessons are learned. Such an approach will catalyse the upscaling of EbA by city management authorities and expand the benefits derived from project activities beyond the project implementation phase. Within this component, the proposed LDCF project will:

- assess city-specific climate change impacts and adaptation needs through a multi-stakeholder engagement process, including workshops with the relevant city management authorities and various urban communities;
- conduct a cost-benefit analysis of urban EbA and relevant hard infrastructure interventions;
- select EbA interventions appropriate to social, cultural and environmental contexts of each pilot city through a multi-stakeholder engagement process, including workshops with the relevant city management authorities and urban communities;
- develop protocols together with relevant stakeholders to guide city-specific EbA interventions in pilot cities;
- implement urban EbA interventions, such as urban reforestation, urban wetland restoration and urban agriculture, in pilot cities to reduce the climate impacts on communities living in vulnerable urban areas;
- develop and promote alternative livelihoods based on the ecosystem services enhanced by urban EbA interventions; and
- establish long-term research programmes in scientific institutions to assess the long-term societal and ecological benefits of urban EbA interventions.

Research on urban EbA under this component will be used in Component 3 to raise public awareness of the potential for urban EbA interventions to reduce climate vulnerability and improve livelihoods. This will facilitate the upscaling of urban EbA approaches throughout the region.

Component 3: Disseminating knowledge and raising public awareness on urban EbA in pilot cities

This component will strengthen the knowledge base for supporting the design of urban EbA interventions, and increase public awareness of the potential of urban EbA interventions to reduce climate change impacts. Within this component, the proposed LDCF project will:

- synthesise lessons learned concerning the implementation of urban EbA interventions;
- disseminate knowledge and lessons learned to local authorities and the public using pamphlets and training workshops;
- distribute knowledge on integrating urban EbA into city planning and management processes on local, national and regional platforms, to facilitate the upscaling of urban EbA approaches throughout the region;
- establish public awareness and training programmes on climate change impacts and appropriate urban EbA interventions.

A.1.4. Additional cost reasoning and expected contributions from the baseline, the LDCF and co-financing

The proposed LDCF project will reduce the vulnerability of vulernable urban communities to climate change by implementing urban EbA interventions within four pilot cities. This will improve the access to essential ecosystem services such as food provision, water filtration, groundwater recharge, flood mitigation and erosion control.

UNEP has secured co-financing commitments of US$ 8.7 million (see Table C) for the proposed LDCF project. This includes co-financing from the UN-Habitat (**WAC Programme** funded by the ADB and **MEK-WATSAN Initiative** funded by the ADB), **PEI**, funded by the Swiss Development Cooperation, Government of Denmark, UNDP and UNEP, **UNEP EbA Flagship Programme** funded by the German Government (BMU) and **UNEP**

Urban EbA project. The proposed LDCF project will enable these investments to be resilient under future climate change conditions. The additional cost reasoning for each component of the LDCF project is described below. A description of the climate change vulnerabilities of the baseline projects versus the adaptation alternative under the LDCF project are presented in Annex B.

Component 1: Institutional strengthening and capacity-building of city management authorities in pilot cities to plan and implement urban EbA

Business as usual scenario:
At present, there is insufficient knowledge and capacity in city management authorities in Bhutan, Cambodia, Lao PDR and Myanmar to develop and implement financially viable and ecologically appropriate urban EbA projects. Climate change programmes in the Asia-Pacific region, such as Cities and Climate Change Initiative (CCCI), Asian Cities Climate Change Resilience Network (ACCCRN) and South East Asia Systems for Analysis Research and Training (SEA START) (see Section A.4 for further details), have begun to increase the capacity of national and local governments to develop climate change adaptation strategies. However, these programmes have not successfully equipped local governments and city management authorities to institute urban EbA interventions. As a result, urban EbA is not included in current business-as-usual programmes or plans to improve the circumstances of urban poor communities in the four focal countries. In order for the four focal countries to integrate urban EbA into development planning adequately, the human resource, institutional and technical capacity of city management authorities needs to be strengthened. This will enable climate change adaptation, pro-poor urban development plans and disaster risk reduction measures to be adequately complemented with urban EbA in the Asia-Pacific region.

Adaptation scenario:
With LDCF funding, the proposed LDCF project will equip city management authorities in pilot cities with the necessary skills for designing and implementing urban EbA projects that build the resilience of urban communities to climate change. This will be achieved by reviewing, consolidating, and disseminating information on: i) the impacts of climate change in urban areas; ii) the effectiveness of urban EbA interventions for increasing climate resilience; and iii) best practice urban EbA techniques. Using this information, policy briefs, technical guidelines, peer-reviewed papers and popular articles[17] on urban EbA will be produced and distributed to policy- and decision-makers. This will strengthen the institutional capacity to include urban EbA in climate change adaptation strategies. City management authorities in pilot cities will also be trained to plan, design and implement urban EbA interventions. In addition, an upscaling strategy will be developed which will include: i) workshops on urban EbA interventions with both government and private sector stakeholders; ii) the development of policy briefs; iii) analysis of the relative costs and benefits of urban EbA approaches; iv) development of a regional upscaling strategy document; and v) a funding mechanism for the implementation of EbA actions. Furthermore, decision-making tools to incorporate urban EbA interventions into urban development plans will be developed. This will enable urban EbA to be implemented in other cities within the Asia-Pacific region. Through this strengthened institutional and technical capacity, as well as through the demonstration of urban EbA interventions under Component 2, the proposed LDCF project will promote the integration of urban EbA into local and national policies, strategies and legislation.

The proposed LDCF project will build upon the ongoing activities of the baseline projects. Cofinancing is estimated to be US$ 826,500 for this component. The additional cost for increasing capacity within city management authorities in pilot cities to implement urban EbA is estimated to be US$ 871,486.

Component 2: Demonstrating urban EbA interventions in pilot cities.

Business as usual scenario:

[17] Popular articles will be easily understood and aimed at policy- and decision-makers with a limited background in climate change adaptation or EbA.

Urban areas in the four focal countries face a range of challenges, which include rapid urbanisation, extensive poverty, social marginalisation and reduced food and water security. There are several programmes underway to address these problems, including the WAC, MEK-WATSAN and PEI baseline projects. However, these projects often do not adequately consider climate change. Many of the current problems and natural hazards affecting urban communities in Bhutan, Cambodia, Lao PDR and Myanmar will be exacerbated by climate change impacts. Likely climate change impacts on urban populations in these countries include flooding, storm surges, heat stress, drought, landslides, and groundwater depletion. These impacts will be associated with damage to infrastructure, an increased spread of life-threatening diseases, loss of life, decreased agricultural yields, reduced food security and a reduction in access to clean water. Until recently, most climate change adaptation interventions in cities have focused on the use of technologies and the development of infrastructure as a means of reducing climate change vulnerability. Although these measures are often appropriate to deal with specific urban problems or climate change threats, they are also usually costly and incompatible with other sustainable development initiatives.

Alternative scenario:
EbA is a cost-effective means of building climate resilience and providing valuable co-benefits to urban communities in the Asia-Pacific region. LDCF resources will be used to increase the resilience of poor and vulnerable urban communities to climate change impacts in pilot cities through the implementation of urban EbA interventions. These interventions will be chosen based on the needs of each pilot city, and are likely to be varied given the wide range of local biophysical and socio-economic contexts. The appropriate urban EbA interventions will be chosen in consultation with local communities and relevant stakeholders. A cost-benefit analysis assessing different urban EbA interventions, as well as alternative hard adaptation interventions, will be conducted. The results of this analysis will be used to inform the selection of cost-effective, as well as environmentally and socially sustainable, interventions. Furthermore, UNEP's EbA Decision Framework Tool will be used to support the urban EbA intervention selection exercise. Overall, urban EbA interventions that complement the ongoing activities of the baseline projects will be prioritised.

Possible interventions include urban reforestation and urban wetland rehabilitation, which are known to increase water availability and mitigate the impacts of flooding; and thus complement the improved water supply and sanitation objectives of the WAC and MEK-WATSAN baseline projects. It is thus very likely that these interventions will be implemented in the pilot cities. Both of these interventions will involve the planting of climate smart tree/shrub species within urban areas. Tree species that are locally adapted and climate-resilient will be selected for planting. Furthermore, species that provide additional benefits such as fruit, fodder and fuelwood will be favoured. The selection of appropriate climate-resilient and beneficial species will form an important part of the urban reforestation and wetland restoration interventions. Species will be characterised according to their flood-tolerance[18], drought-tolerance[19], ability to provide climate change adaptation benefits[20], and ability to provide community benefits[21] (see annex A for an example from Cambodia which will be developed for all pilot cities). This will enable local communities to derive the greatest climate change adaptation benefits from these urban EbA interventions.

Urban reforestation will involve planting a variety of selected tree species within the urban environment of pilot cities. Climate-resilient trees will be planted along sidewalks, in green spaces within pilot cities, in vacant lots, in peri-urban areas or within gardens. If appropriate, terracing will be used to establish tree species that are climate resilient on steep slopes near slums to reduce the potential for landslides. By increasing the vegetative cover within pilot cities, urban reforestation will reduce the climate change impact of heat stress. Furthermore, urban reforestation will reduce air pollution and the associated public health risks. Urban reforestation also mitigates flooding, and thereby improves sanitation, limits mosquito numbers and reduces the spread of disease. The co-

[18] Flood-tolerant species will be characterized by deep and extensive root systems, fast growth rates and ability to tolerate extended periods of inundation.
[19] Drought-tolerant species will be adapted to dry conditions. Widespread species that show high levels of phenotypic plasticity and grow in a range of different climatic conditions are favourable.
[20] Plant species can provide a range of adaptation benefits, including: i) plants with extensive root systems bind soil and prevent erosion associated with heavy rainfall; ii) trees with wide canopies provide shade thereby reducing heat stress; iii) nitrogen-fixing species improve soil fertility, increasing productivity and thus increasing food security; and iv) flowering plants can increase the population of pollinators, increasing agricultural productivity
[21] Plant species that provide a range of additional benefits will be favoured. Plant species will be characterised in terms of their ability to provide: i) food (fruit, berries); ii) fodder; iii) medicinal uses; iv) resin; v) fibre; vi) timber; and vii) charcoal.

benefits of urban reforestation include sound buffering, increased food security – through the provision of non-timber forest products – and reduced surface runoff and erosion.

Degraded wetlands within pilot cities will be rehabilitated, using selected climate-resilient species. Urban wetland restoration will reduce flooding and erosion. It will also aid in the maintenance of water quality and availability, thereby increasing the climate resilience of urban communities. Fish and waterfowl associated with restored wetlands will improve food security, further contributing to climate resilience of poor urban dwellers in particular.

Urban agriculture is another adaptation intervention available to pilot cities which involves the planting of climate resilient food plants and trees within and on the fringes of pilot cities. Urban agriculture interventions will be established in green spaces within cities, in gardens, in peri-urban areas, in vacant lots or on the roofs of buildings. Furthermore, in areas where there is limited open space available, alternative solutions such as tyre[22] or sack gardens[23] will be considered. This intervention can build the climate resilience of poor urban communities by diversifying urban food sources and income opportunities[24]. The secondary jobs created through urban agriculture (for example, street vending of food) provide alternative livelihood strategies and further help to build climate resilience of vulnerable urban communities. Moreover, urban agriculture provides the opportunity for adding value through product beneficiation, and allows these communities to access vendors/local markets via value chains. Enhanced vegetative cover within the city associated with urban agriculture also reduces heat stress and air pollution.

Through the implementation of one or more of these urban EbA interventions, urban communities will have consistent long-term adaptation benefits including: i) increased buffering for extreme weather events; ii) reduced erosion and sedimentation; iii) increased water and food supplies; iv) increased livelihood options; and v) increased social and human adaptive capacity. This will assist local communities to recover quickly after extreme weather events as well as adapt to future climate changes.

The proposed LDCF project will develop and promote alternative livelihoods based on the ecosystem services enhanced by the city-specific urban EbA interventions within this component. Furthermore, long-term research programmes will be established in scientific institutions to assess the long-term social and environmental benefits of different urban EbA interventions. This knowledge will help guide the choice of urban EbA interventions in other cities within the Asia-Pacific region.

The proposed LDCF project will build upon the ongoing activities of the baseline projects. Cofinancing is estimated to be US$ 6,198,750 for this component. The additional cost for implementing urban EbA interventions within pilot cities is estimated to be US$ 4,286,143.

Component 3: Disseminating knowledge and raising public awareness on urban EbA in pilot cities.

Baseline scenario:

[22] A tyre garden is a small garden established in a used tyre. The tyres are filled with fertilisers/manure and soil, and small quantities of vegetables are grown. Tyre gardens require minimal water inputs. See: www.fao.org/docrep/009/a0218e/a0218e01.htm.

[23] Small gardens can be established in sacks placed around a dwelling. The garden in a sack concept is an effective, simple and sustainable method of ensuring food security for slum dwellers. The households are either able to earn an income or save on costs that they would otherwise incur to buy food. This concept has proven successful in Nairobi, Kenya. See: Pascal, P. and Mwende, E. 2009. A Garden in a Sack: Experiences in Kibera, Nairobi. Urban Agriculture magazine 21 January 2009. Available at http://www.ruaf.org/sites/default/files/UAM21%20p.38-40.pdf

[24] Recent studies have shown that home gardens can provide a significant proportion of the fruits and vegetables consumed by households (60% of leafy vegetables, 20-50% of all fruit and vegetables). There is also evidence that home gardens significantly reduce the number of malnourished children in poor communities. The Center for Sustainable Development. http://www.csd-i.org/csdi-blog/2013/6/12/international-adaptation-workshop-northern-nonprofit-project.html. Accessed 14 June 2013.

Regional knowledge sharing networks, climate change programmes and initiatives currently underway in the Asia-Pacific region – such as APAN, ACCCRN and CTCN (see Section A.4 for further details) – are increasing the awareness of climate change impacts in national governments. This knowledge, however, is often not effectively communicated to local goverments and local communtieis. Furthermore, when knowledge and awareness is disseminated, it is often focussed on climate change mitigation rather than adaptation. Therefore at present, relevant local government entities, city management authorities and other stakeholders in Bhutan, Cambodia, Lao PDR and Myanmar have a limited knowledge of EbA in general, and almost no knowledge of urban EbA. The lack of information and awareness is one of the main barriers to the implementation and integration of urban EbA into development planning processes.

Alternative scenario:
With LDCF funding, the proposed project will strengthen the knowledge base for supporting the design of urban EbA interventions. This will be achieved by: i) collating the lessons learned on the implementation of urban EbA interventions; ii) synthesising knowledge generated on integrating urban EbA approaches into development planning; and iii) disseminating all of this information on local, national and regional networks including conferences, workshops and web-based platforms. Enhancing knowledge sharing across ecosystems and communities has been identified in UNEP as an important means of promoting EbA.[25] Therefore, this project will also be linked with similar projects in other regions namely the UNEP SCCF project in Latin America and the Caribbean entitled ' Building climate resilience of urban systems through Ecosystem-based Adaptation (EbA) in Latin America and the Caribbean, in order to facilitate the sharing of knowledge and lessons learnt across regions. LDCF funding will also be used to introduce public awareness programmes in pilot cities. Local communities will be trained on climate change impacts, urban EbA interventions and the benefits associated with these interventions.

The knowledge generated, disseminated and the increased public awareness created in Component 3 will facilitate and feed into the upscaling of urban EbA interventions.

The proposed LDCF project will build upon the ongoing activities of the baseline projects. Cofinancing is estimated to be US$ 1,239,750 for this component. The additional cost for disseminating knowledge and increasing public awareness of urban EbA is estimated to be US$ 557,229.

Please refer to Annex B which provides a summary of the baseline projects, climate hazards, their impacts to the baseline projects, targeted ecosystem services as well as adaptation measures proposed by the project.

A.1.5. Adaptation benefits

The urban EbA interventions to be implemented under Component 2 of the proposed LDCF project will provide numerous adaptation benefits at the local level. By increasing the vegetative cover within a city, urban reforestation will reduce heat stress, air pollution and the associated public health risks. Soil erosion will be reduced by selectively planting climate-resilient species with extensive root systems and wide canopies that bind soil and reduce raindrop impact. Urban reforestation will also provide the co-benefits of increased food and water security, through the selective planting of species that provide non-timber forest products, such as fruit and resin. In addition, large scale urban reforestation has known to lower the demand for electricity, by decreasing the need for air-conditioners, thereby reducing green house gas emissions[26]. The restoration of wetlands in urban areas with climate-resilient plant species will slow water flow, and thus serve to reduce flooding and erosion. Restored wetlands will also aid in maintenance of water quality and availability. Healthy wetlands support a higher abundance of fish and waterfowl, which can be sustainably harvested to improve food security for the urban poor. Co-benefits associated with wetland protection and restoration are their social and cultural value, potential economic advantages (tourism, job opportunities) and biodiversity conservation. Climate-resilient urban agriculture will reduce the vulnerability of urban communities to climate change by diversifying urban food sources and

[25] UNEP/ROAP 2013. Ecosystem Based Adaptation in Mountain Ecosystems in Nepal: A Review and Compilation of Good Practices.
[26] Solecki, W.D., C. Rosenzwieg, L. Parshall, G. Pope, M. Clark, J. Cox & M. Wiencke. 2005. Mitigation of the heat island effect in urban New Jersey. Environmental Hazards 6: 39-49

income opportunities. The secondary jobs created through urban agriculture (for example, street vending of food) will provide alternative livelihood strategies and help to build climate resilience of poor urban communities. The creation of green spaces designed to be climate-resilient has the added benefits of controlling storm water flows by facilitating water storage and increased infiltration of excess water.

The adaptation benefits associated with the urban EbA interventions will initially accrue within each of the four pilot cities. However, research/knowledge generated and consolidated under Component 3, as well as the development of an upscaling strategy, will promote the sustainable expansion and replication of local level interventions throughout the region. This will enable the proposed LDCF project's climate change adaptation benefits to cover greater geographic scales and persist long after project completion.

At the national and regional level the benefits delivered by the proposed LDCF project under Component 1 will include strengthening of institutional and staff technical capacities to increase the climate resilience of urban areas through an urban EbA approach. This will allow city management authorities and local government to plan and implement urban EbA in other cities.

A.1.6. Innovation, sustainability and potential for scaling up

A growing body of research indicates that EbA projects deliver favourable cost/benefit ratios when compaired with or paired with hard adaptation measures. This is because EbA can help support governments to meet their adaptation needs as well as mitigation commitments and development goals. EbA reduces climate change vulnerability while simultaneously providing a range of co-benefits such as carbon storage and sequestration, biodiversity conservation, alternative livelihoods, and poverty reduction opportunities. Up until now, EbA approaches have been applied predominantly in rural settings. The proposed LDCF project shows additional innovation by implementing EbA in an urban context.

To enable the proposed LDCF project's concepts, directions and interventions to be sustainably expanded and replicated, the LDCF project will: i) build a robust knowledge base for designing appropriate urban EbA interventions in the face of climate change, and make this knowledge available on local, national and regional platforms to facilitate the upscaling of urban EbA approaches throughout the region; ii) undertake institutional strengthening and capacity building of city management authorities and local government to facilitate the replication of urban EbA interventions in other cities; iii) develop decision-making tools to integrate urban EbA into development planning that can be applied at a regional level; iv) develop an upscaling strategy including a financial mechanism for EbA actions; v) establish public awareness and training programmes on climate change impacts and the potential for urban EbA interventions to increase climate resilience; and vi) demonstrate the benefits of urban EbA to local communities and governments by implementing urban EbA interventions in four pilot cities.

A.2. Stakeholder Engagement

Key stakeholders of the proposed LDCF project include local communities, district administrations, and government agencies. The proposed LDCF project will build upon a consultative and participatory approach. Stakeholder participation and validation of key processes is expected for all activities. Stakeholder consultations around proposed activities will mobilise local communities, initiate discussions and promote buy-in from local communities. This project will create active partnerships with NGOs at the local and national level, with private sector partners in the pilot cities, and with relevant onging initiatives and projects (to be updated during the PPG phase). Research institutions, both national and international, will be engaged to provide the scientific basis for designing and implementing urban reforestation, urban agriculture and urban wetland restoration interventions. Furthermore, these research institutions will play an important role in assessing the long-term societal and ecological benefits of urban EbA.

The proposed LDCF project will build the climate resilience of marginalized populations living in urban areas. Slum dwellers, renters in low-income neighbourhoods, women and women-headed households, people who depend on urban agriculture, recent migrants and daily wage labourers are among the target beneficiaries for this project.

Targeting these groups will ensure that representation of women and other vulnerable demographics is emphasised when selecting pilot sites.

At the commencement of the PPG phase, an inception workshop will be convened for all major stakeholders. During this workshop, a project steering committee will be formed. A range of urban EbA interventions will be identified during the PPG, as well as the selection criteria for deciding on the most appropriate interventions. Criteria to identify pilot cities will also be reviewed. The selection of interventions and project sites will take place during mapping workshops, where community members and experts in fields related to the project interventions (e.g. socio-economic development experts, civil engineers, agricultural specialists, restoration scientists, forestry officials, town-planners) assess the potential adaptation interventions, the selection criteria and the process for selecting appropriate demonstration sites. The inception and mapping workshops will also enable the: i) collection of baseline information; ii) documentation of ongoing initiatives and potential areas of collaboration; and iii) the initiation of discussions with potential implementing and co-financing partners.

A.3. Risks and mitigation measures

A number of risks to the successful implementation of the proposed LDCF project are assessed and summarized in Table 1 below, along with appropriate countermeasures and management responses to minimize the potential threat posed by the specific risk. Risks will be validated and re-assessed during the PPG phase.

Table 1: Risks, rating and mitigation measures

Identified Risks	Risk rating	Mitigation Measures
Unfavourable climate conditions including current climate and seasonal variability and/or extreme weather events may affect implementation.	High	• City-specific current climatic variability will be taken into account in the selection of the appropriate urban EbA interventions. • Appropriate climate-resilient species for urban reforestation and urban agriculture will be selected.
Resistance of city management authorities to adopt EbA in favour of hard engineering adaptation interventions.	Medium	• The benefits of appropriate city-specific urban EbA interventions will be demonstrated in pilot cities. • City management authorities in each of the four pilot cities will be trained in the design, planning and implementation of urban EbA interventions.
Resistance of communities in pilot cities to adopt urban EbA interventions during and/or after project implementation may negatively the project objectives.	Medium	• Public awareness programmes on climate change impacts and the benefits of urban EbA interventions will be established. • The benefits of appropriate city-specific urban EbA interventions will be demonstrated in pilot cities. • Capacity building and training of important stakeholders will be conducted to increase their understanding/awareness of the benefits of urban EbA.
Variation in local adaptation capacities among the targeted countries may reduce efficiency in project execution and impede coordination.	Medium	• City management authorities in each of the four pilot cities will be trained in the design, planning and implementation of urban EbA interventions. • International experts will be engaged to assist local authorities to implement the city-specific urban EbA interventions.
Capacity and mandate constraints of local institutions may limit the ability to undertake the required research/assessments and project interventions.	Medium	• Collaboration and exchange between local and national institutions, and international research institutes will be initiated. • Human resource capacity will be developed as required. • International experts will be engaged to assist local researchers and institutions
The cost-effectiveness of implementing Urban EbA interventions is lower than expected which will negatively affect the potential for upscaling.	Low	• Cost-effectiveness will be a core principle in the selection and implementation of city-specific urban EbA interventions. Detailed information will be recorded regarding cost effectiveness.

A.4. Coordinationwith other relevant GEF financed and other initiatives:

The proposed LDCF project will coordinate closely with public, private and local community stakeholders that are involved in the design and implementation of the following initiatives.

- Partnerships in Environmental Management for the Seas of East Asia (PEMSEA), which is an ongoing initiative aimed at strengthening consensus among partners (including Cambodia and Myanmar) on approaches and strategies for addressing the identified threats to the environment and sustainable development in the Seas of South East Asia.
- South East Asia Systems for Analysis Research and Training (SEA START), which is an on-going programme focused on: i) developing integrated scientific and social-economic approaches to reduce uncertainties of forecasting and assessing impacts of environmental change for South East Asia; ii) providing recommendations to governments to cope with long-term environmental change; iii) encouraging the sharing of environmental data and information within and between regions; and iv) promoting public awareness on global environmental issues.
- Asian Cities Climate Change Resilience Network (ACCCRN) funded by the Rockefeller Foundation, which was established to develop urban climate change resilience strategies and implement them across ten cities in India, Indonesia, Thailand and Vietnam.
- UN-Habitat Cities and Climate Change Initiative (CCCI), which is a global project that targets medium-sized cities in developing countries. It is an ongoing project that emphasises good governance and practical initiatives for municipalities to address climate change.
- Ecosystem Based Adaptation to Climate Change in Mountain Ecosystems, funded by BMU (German Government), and which is a flagship programme of UNEP, UNDP and IUCN. The project aims to strengthen the institutional capacities of Nepal, Peru and Uganda to implement EBA and to reduce the vulnerability of communities, with a particular emphasis on mountain ecosystems.
- The Adaptation Fund financed "Enhancing climate change resilience of rural communities living in protected areas of Cambodia" project (2013 – 2017; ~ US$ 5 million). This project will use an ecoagriculture approach to build the resilience of rural Cambodian communities living in protected areas to climate change.
- The LDCF funded project "Vulnerability assessment and adaptation programme for climate change within the coastal zone of Cambodia considering livelihood improvement and ecosystems" (2011 – 2014; US$ 1.635 million). Implemented by UNEP, this project is reducing the vulnerability of coastal communities in Cambodia to the impacts of climate change by strengthening policy and science, and demonstrating targeted local interventions to increase ecosystem resilience.
- Climate Technology Centre and Network, hosted by UNEP, which aims to build or strengthen the capacity of developing countries to: i) identify technology needs; ii) facilitate the preparation and implementation of technology projects and strategies taking into account gender considerations; iii) support action on mitigation and adaptation, and iv) enhance low emissions and climate-resilient development.
- Urban EBA project, which is a part of the EbA flagship programme of UNEP, UNDP and IUCN and is funded by the BMU (German Government). The project promotes the use of EBA approaches to increase the resilience of urban communities to climate change and is providing co-financing of 200,000 USD towards this project.
- China SCCF project "Enhancing capacity, knowledge and technology support to build climate resilience of vulnerable developing countries) (2012 – 2017; US$ 39.6 million" is funded by GEF, UNEP, National Development and Reform Commission of China and the Governments of Nepal, Seychelles and Mauritania.
- Asia Pacific Adaptation Network (APAN) is an on-going initiative funded by the ADB, which aims to: i) improve understanding and knowledge of adaptation to past, current and future climate conditions; ii) enhance capacity to design and implement adaptation actions; and iii) strengthen the ability to integrate adaptation into development.
- ICLEI - Local Governments for Sustainability, which is dedicated to sustainable development throughout the Asia-Pacific region. ICLEI provides technical assistance, training and information services to build capacity and share knowledge as well as support the implementation of sustainable development at the local level.
- Myanmar Climate Change Alliance (MCCA) project, which began in 2013 and was developed jointly by UNEP and UN-Habitat with funding from the EC under the Global Climate Change Alliance (GCCA).

- Action Plan for Clean Air and Sustainable Mobility: Thimphu, Bhutan, which was developed in 2012 and outlines a strategy to maintain and improve air quality in Thimpu.
- Build on lessons learned from the recently approved UNEP SCCF project entitled 'Building climate resilience of urban systems through Ecosystem-based Adaptation (EbA) in Latin America and the Caribbean.'

In addition to the above, the proposed LDCF project will coordinate with other donors and agencies of the GEF who are in the process of developing adaptation projects and applying for LDCF funding.

B. DESCRIPTION OF THE CONSISTENCY OF THE PROJECT WITH:

B.1.National strategies and plans or reports and assessments under relevant conventions

The proposed LDCF project is consistent with the following priority activities identified in the Bhutan NAPA: 4) Landslide Management and Flood Prevention; and 5) Flood Protection of Downstream Industrial and Agricultural Areas. Urban wetland restoration reduces flooding and erosion by slowing water flow. Furthermore, the enhancement of vegetative cover from urban reforestation and urban agriculture reduces the severity of flooding by enhancing infiltration and retention of water in soils. Thus, the urban EbA interventions to be implemented by the proposed LDCF project will contribute to flood prevention and protection in Bhutan.

In Cambodia, agriculture, forestry and human health are among the sectors identified as being most vulnerable to the impacts of climate change. The proposed LDCF project has been designed to increase climate resilience in these sectors. Furthermore, the proposed LDCF project is aligned with the following priority activities identified in Cambodia's NAPA: 2a) Development and Rehabilitation of Flood Protection Dikes; 3f) Promotion of Household Integrated Farming; and 3a) Vegetation Planting for Flood and Windstorm Protection.

Agriculture, Forestry and Water have been identified as priority sectors in Lao PDR's NAPA. In the agriculture sector, the proposed LDCF project will address the following priority activities: 2) Promote secondary professions in order to improve the livelihoods of farmers affected by natural disasters induced by climate change; and 3) Land use planning in hazard prone and affected areas. Through the implementation of urban agriculture and urban reforestation interventions, the proposed LDCF project will address the following priority activities in the forestry sector: 4) Promote and establish tree nurseries to provide saplings to areas at high risk from flooding or drought; and 8) Develop agro-forestry systems for watershed protection and erosion reduction in steep areas. In the water sector, the proposed LDCF project will address the following priority activities: 1) Awareness raising on water and water resource management; and 4) Strengthen institutional and human resource capacities related to water and water resource management.

The proposed LDCF project has been designed to address Myanmar NAPA Priority Adaptation Projects for First Level Priority Sectors: Agriculture and Forestry. In alignment with Priority Adaptation Projects identified by the Myanmar NAPA for these sectors, the proposed LDCF project will enhance the climate resilience of urban communities through the introduction of urban agriculture and urban reforestation in a pilot city.

B.2. GEF Focal area and/or fund(s) strategies, eligibility criteria and priorities

The proposed LDCF project has been developed using the Updated Results-Based Management Framework for the Least Developed Countries Fund (LDCF) and Adaptation Monitoring and Assessment Tool (GEF/LDCF.SCCF.9/Inf.4 October 20, 2010) and the "Operational Guidelines on Ecosystem-based approaches to Adaptation (GEF/LDCF.SCCF.13/Inf.06 October 16, 2012). In line with the LDCF eligibility criteria and priorities (Decision 7/CP.7), the proposed LDCF project has been designed to meet the urgent and immediate adaptation needs of Bhutan, Cambodia, Lao PDR and Myanmar as identified in their respective NAPAs (see Section B.1).

The LDCF project corresponds to: i) Objective CCA-1 "Reducing Vulnerability: Reduce vulnerability to the adverse impacts of climate change, including variability, at local, national, regional and global level"; ii) CCA-2 "Increasing Adaptive Capacity: Increase adaptive capacity to respond to the impacts of climate change, including variability, at local, national, regional and global level;" and iii) CCA-3 "Adaptation Technology Transfer: Promote

transfer and adoption of adaptation technology. Table A indicates the funds that are being allocated to the relevant Focal Areas under the Results-Based Management Framework.

In line with the LDCF eligibility criteria and priorities, the project will use LDCF resources to finance the additional costs needed for increasing the climate resilience of poor urban communities in four pilot cities. This will be achieved by building on PEI and UN-Habitat baseline projects and strengthening capacities and technical knowledge in city management authorities for designing and implementing urban EbA projects. Furthermore, and in line with the LDCF guidelines, the proposed LDCF project has been developed and will be implemented using the following approaches: i) participatory (communities and relevant stakeholders); ii) learning-by-doing; iii) multi-disciplinary; iv) complementary to other relevant initiatives; and v) gender-sensitive.

B.3. The GEF Agency's comparative advantage for implementing this project

The proposed LDCF project is consistent with UNEP's comparative advantage in providing proof of concept and the best available science and knowledge upon which investments can be based. The project focuses on knowledge of ecosystems and adaptation technology, in which UNEP has taken the lead, and is in line with the UNEP's core business of providing technical advice on ecosystem management.

UNEP has considerable experience implementing climate change adaptation projects through LDCF resources and providing scientific guidance in the field of climate change. To date, UNEP has facilitated the completion of 15 NAPAs and has assisted 38 countries in developing their National Communications. UNEP is also assisting LDCs and other developing countries implement adaptation priorities identified by their NAPAs, National Communications and Technology Needs Assessments. The project will also benefit from UNEP's expertise and active network of local practitioners focused on municipal level environmental issues through on-going Geo Cities processes. Furthermore UNEP's role with regard to creating resilient and sustainable cities for the future has been solidified through a recent meeting with the Executive Director of UNEP, and the Director-General of UNHABITAT at which they agreed on a 'greener cities' joint program of work for the next three years led by 'resilient, resource efficient cities' programme.

The proposed LDCF project is built on UNEP's experience gained through the implementation of more than 90 adaptation projects (GEF and non–GEF) at global, regional and national levels. Through the implementation of those projects, UNEP works to develop innovative solutions for national governments and local communities to adapt in an environmentally sound manner to climate change.

UNEP's Flagship Ecosystem-based Adaptation Programme represents a ground-breaking shift in focus in the realm of climate change adaptation, which has been commended by the Conference of the Parties to the UNFCCC (CoP). The EbA approach is multidisciplinary in nature, and involves managing ecosystems to build their resilience, and use ecosystem services to promote climate change adaptation and disaster risk management. This approach has been endorsed by GEF, IUCN and the EC, and will provide a platform to engage a broad range of stakeholders and sectors in the adaptation process. Through the proposed LDCF project, UNEP will expand their core EbA portfolio into urban areas, demonstrating a new approach for increasing the climate resilience of cities and providing multiple societal and environmental benefits. Furthermore, the project will link up with and build upon the UNEP GEF SCCF Urban EbA LAC. Lessons learned on the applications of Urban EbA in various contexts will be drawn upon and feed into the development of similar projects in other regions namely in Africa.

Finally, through its regional office (ROAP) UNEP has a long-standing engagement with many Asian countries in helping them to address climate change impacts. This includes, *inter alia* i) integrated environment assessments and capacity building at sub-regional, national and city level on adaptation to climate change in Bangladesh; ii) integrating climate change adaptation into city level planning in the Philippines; and iii) training government officials on mainstreaming ecosystem-based disaster risk reduction and adaptation in development planning in Sri Lanka. UNEP is also implementing the project "Enhancing capacity, knowledge and technology support to build climate resilience of vulnerable developing countries" in China and Nepal.

PART III: APPROVAL/ENDORSEMENT BY GEF OPERATIONAL FOCAL POINT(S) AND GEF AGENCY(IES)

A. RECORD OF ENDORSEMENT OF GEF OPERATIONAL FOCAL POINT (S) ON BEHALF OF THE GOVERNMENT(S):

NAME	POSITION	MINISTRY	DATE *(MM/dd/yyyy)*
Dr Lonh Heal	Director General	MINISTRY OF ENVIRONMENT	10/12/2013
Khampadith Khammounheuang	Director General, Department of Environmental Quality Promotion	MINISTRY OF NATURAL RESOURCES AND ENVIRONMENT	18/12/2013
Hla Maung Thein	Deputy Director General, Environmental Conservation Department	MINISTRY OF ENVIRONMENT CONSERVATION AND FORESTRY	31/12/2013
Karma Tshiteem	Secretary	GROSS NATIONAL HAPPINESS COMMISSION	4/4/2013

B. GEF AGENCY(IES) CERTIFICATION

This request has been prepared in accordance with GEF/LDCF/SCCF/NPIF policies and procedures and meets the GEF/LDCF/SCCF/NPIF criteria for project identification and preparation.

Agency Coordinator, Agency name	Signature	DATE *(MM/dd/yyyy)*	Project Contact Person	Telephone	Email Address
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Appendix A: Climate change vulnerabilities of the baselines projects versus the adaptation alternative under the proposed LDCF project being implemented in Bhutan, Cambodia, Lao PDR and Myanmar.

Baseline projects • **Goals and activities**	**Climate change hazards affecting the project area**	**Impacts to the baseline projects and targeted populations as a result of climate change**	**Ecosystem services targeted by the proposed LDCF project**	**Adaptation measures supported by proposed LDCF project**	**How the proposed LDCF project will contribute towards increasing the resilience the baseline projects**
Project targeted vulnerable sites and communities: Poor urban communities in 4 pilot cities; 1 city in each of Bhutan, Cambodia, Lao PDR and Myanmar.					
Water for Asian Cities (WAC) Programme • Supports cities to meet water and sanitation related MDGSs. • Enhances capacity at city, country and regional levels to supply water and sanitation requirements. • Creates an enabling environment for pro-poor investments in the water and sanitation sectors.	Increased frequency of heavy rains and floods. Increased frequency of droughts, due to increased temperatures and decreased precipitation. Increased temperatures, causing increased heat stress. Increased frequency of landslides.	Reduced water available for domestic use and sanitation. Contamination of water sources during flooding. Local community activities including agriculture and tourism affected by water scarcity and/or flooding. Increased spread of disease because of damage to sanitation infrastructure by floods and landslides. Increased heat stress leading to a decreased resilience to disease.	Fresh water provision. Water purification. Flood mitigation. Maintenance of soil fertility.	Increasing the capacity of city management authorities to plan and implement appropriate urban EbA interventions. Strengthening the information base of scientific knowledge to support the design of urban EbA interventions. Demonstrating urban EbA interventions and their associated benefits, particularly with regards to water provision and sanitation.	Local stakeholders are aware of climate change hazards and their impacts on water and sanitation infrastructure. Urban reforestation and urban wetland restoration interventions with climate-resilient plant species reduce the negative impacts of climate change on water availability. Urban EbA interventions reduce urban heat island effect, thereby reducing heat stress and susceptibility to disease. Government institutions strengthened and capacity built to plan and implement urban EbA interventions which climate proof water supply and sanitation ac-

Baseline projects • **Goals and activities**	**Climate change hazards affecting the project area**	**Impacts to the baseline projects and targeted populations as a result of climate change**	**Ecosystem services targeted by the proposed LDCF project**	**Adaptation measures supported by proposed LDCF project**	**How the proposed LDCF project will contribute towards increasing the resilience the baseline projects**
					tivities.
Mekong Region Water and Sanitation Initiative (MEK-WATSAN) • Expedites pro-poor water and sanitation investments. • Enhances institutional and human resource capacities at local and regional levels to meet water and sanitation requirements. • Enhances capacities of local private sector entities in service delivery. • Reduces the adverse environmental impact of urbanization on the local environment.	Increased frequency of heavy rains and floods. Increased frequency of droughts, due to increased temperatures and decreased precipitation. Increased temperatures, causing increased heat stress. Increased frequency of landslides.	Frequent floods and heavy rainfall events damage water supply and sanitation provision infrastructure. Droughts reduce water availability for local populations. Heat stress, due to increased temperatures, negatively affects the health of local communities. Flooding leads to contaminated water supplies and increases the incidence of water-borne disease. Landslides damage water supply and sanitation provision infrastructure.	Flood mitigation in restored wetlands. Fresh water provision. Micro-climate regulation. Erosion control.	Increasing the capacity of city management authorities to plan and implement appropriate urban EbA interventions. Demonstrating urban EbA interventions and their associated benefits, particularly with regards to water provision and sanitation. Increasing the climate resilience of urban communities to climate change impacts through urban EbA interventions.	Local stakeholders are aware of climate change hazards and their impacts on water and sanitation infrastructure. Urban EbA interventions will reduce climate change impacts (such as floods and landslides) on water and sanitation infrastructure. Local populations have increased food security because of urban interventions, and are thus less susceptible to disease. Government institutions strengthened and capacity built to plan and implement urban EbA interventions which climate proof water supply and sanitation activities.

Baseline projects • **Goals and activities**	**Climate change hazards affecting the project area**	**Impacts to the baseline projects and targeted populations as a result of climate change**	**Ecosystem services targeted by the proposed LDCF project**	**Adaptation measures supported by proposed LDCF project**	**How the proposed LDCF project will contribute towards increasing the resilience the baseline projects**
Poverty Environment Initiative (PEI) • Develops capacity for research and analysis on economic valuation of ecosystem services. • Improves the capacity of national and provincial government to plan and manage pro-poor, pro-environment investments.	Higher temperatures exacerbating urban heat island effects. Unpredictable rainfall patterns leading to increased incidence of flooding, droughts and landslides.	Higher temperatures and unpredictable rainfall patterns decrease the food security of poor urban populations increasing their vulnerability. Floods and landslides damage infrastructure.	Food provision. Flood mitigation in restored wetlands. Erosion control. Soil stabilisation.	Increasing the awareness on EbA implementation benefits. Developing national upscaling strategies to promote urban EbA approaches. Establishing long-term research programmes to increase regional knowledge of urban EbA.	Regional development strategies consider climate change risks and appropraite adaptation measures including urban EbA. City management authorities and the public are aware of climate change and the potenial benefits of urban EbA, and incorporate this into their decision-making regarding new investments.

Appendix B: Summary of observed climate variability and associated impacts in Asia-Pacific[27]

Climate variability	Impacts
Water	
Rising temperature resulting in rapid thawing of permafrost, decrease in depths of frozen soils, rapid melting of glaciers.	Increase in glacial runoff and frequency of glacial lake outbursts causing frequent landslides, mudflows and avalanches resulting in degeneration of ecosystems.
Rise in temperature and decreases in precipitation commonly associated with ENSO.	Increased water shortages. Drying up of lakes and rivers.
Agriculture and food security	
Increasing water stress from increasing temperature, increasing frequency of El Niño and reduction in the number of rainy days.	Declines in production of rice, maize and wheat. Declines in good agricultural land in East Asia.
Coastal zones	
Extreme climatic events resulting in coastal flooding.	Substantial economic losses and fatalities. Coastal erosion resulting in loss of land. Loss of mangroves in South-East Asia.
Severe droughts.	Sea-water intrusion in the coastal plains.
1997/98 El Niño event.	Over 34% of the vast and diverse coral reefs of Asia lost in 1998 due to coral bleaching particularly in South-East and East Asia.
Terrestrial ecosystems	
Rise in temperature and declines in precipitation.	Increasing intensity and spread of forest fires. Fires in peatlands of Indonesia during the 1997 to 98 El Niño dry season affected over 2 million ha. The 1997/98 ENSO event in Indonesia also triggered forest and brush fires in 9.7 million ha, with serious domestic and trans-boundary pollution consequences.
Precipitation declines and droughts.	Drying up of wetlands and severe degradation of ecosystems. Most delta regions of Pakistan, Bangladesh, India and China have been affected.
Human Health	
Extreme summer temperatures and heatwaves	Death mainly among the poor, elderly and labourers such as rural daily wage earners, agricultural workers and rickshaw pullers. Endemic morbidity and mortality due to diarrhoeal disease.
Severe floods, ENSO-related droughts, sea-surface temperatures and rainfall.	Diarrhoeal diseases and outbreaks of other infectious diseases (e.g., cholera, hepatitis, malaria, dengue fever).

[27] Cruz, R.V., H. Harasawa, M. Lal, S. Wu, Y. Anokhin, B. Punsalmaa, Y. Honda, M. Jafari, C. Li and N. HuuNinh, 2007: Asia. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 469-506.

Appendix C: Example of appropriate climate-resilient and multi-use tree species selection in Bhutan, Cambodia, Lao PDR and Myanmar.

The table below presents a preliminary list of tree species that are likely to be appropriate for the urban EbA interventions in Bhutan, Cambodia, Lao PDR and Myanmar. The most appropriate species will be selected at the beginning of project implementation based on expert advice. Trees have been prioritised based on their climate change adaptation value and properties such as food production, soil stabilisation, drought tolerance and other NTFPs.

Scientific or available name	Indigenous	Exotic	Food	Soil Stabilisation	Drought tolerant	Fodder	Apiculture (Honey)	Soil Fertility[28]	Medicines	Resin	Fibre	Mulch/leaf litter	Timber	Woodfuel	Charcoal	Crop cover/Shade	Description of bio-physical parameters
Senna siamea	x		x	x		x		x	x			x	x	x	x	x	A medium-sized, evergreen tree (up to 18 m). Altitude 0-1000 m; mean annual temperature between 20-31 ºC; mean annual rainfall: 400-2800 mm. Performs best on deep well-drained fertile soils with pH 5.5-7.5, but will grow on degraded lateritic soils provided drainage is not impeded. The species is intolerant of saline soils.
Morus alba	x		x	x		x		x			x	x	x	x		x	A medium-large tree (up to 35 m). Altitude 0-3300 m; mean annual temperature 0-43 ºC; mean annual rainfall: 1500-2500 mm. The plant grows on a variety of soils ranging from sandy loam to clayey loam, but prefers deep, alluvial, loamy soil with sufficient moisture and pH 6.0-7.5.
Bambusa spp.	x		x	x		x						x					An evergreen multi-stem grass (bamboo) up to 25-35 m tall and culm diameters of 8-10 cm. Altitude 0-2000m; mean annual temperature 8 - 36 ºC; mean annual rainfall:1200-2500 mm. Good species for restoration of forest areas and stabilizing eroding areas. This species is one of the best bamboos for windy sites due to the strength of the culms.
Morinda citrifolia	x		x						x				x	x		x	An evergreen shrub (3-10 m). Altitude 0-1500 m; mean annual temperature unknown; mean annual rainfall: 1500-3000 mm. In areas where the plant is cultivated, the soil is usually well structured and of volcanic origin (Java), but it may be poor and ferralitic (Cambodia). The plant also occurs on infertile, degenerated soils, sometimes badly drained or with a very low water-retention capacity and a deep water table.
Calamus spp.	x								x		x		x				Perennial clustering, moderate-sized, high-climbing, evergreen rattans with canes reaching a length of 100 m. Altitude 0-800 m. Grows for 6 years before the first harvest and needs 15 years before full production.
Albizia saman		x	x			x		x		x		x	x	x	x	x	A large semi-deciduous tree from (up to 60 m). Altitude: below 0 -1300 m; mean annual temperature: 20-35 ºC; mean annual rainfall: 600-3000 mm. Found on neutral to moderately acid soils and can grow on soil with pH as low as 4.6. It grows on light or heavy soils and tolerates infertile or waterlogged conditions.
Borassus flabellifer		x	x		x						x	x	x	x		x	A large solitary, pleonanthic, dioecious palm (25-40 m). Altitude: below 0 -800 m; mean annual temperature: 30-45 ºC; mean annual rainfall: 500-5000 mm. It can be found on any kind of soil, preferring soils rich in organic material
Cajanus cajun		x	x	x		x	x	x			x	x		x		x	Short-lived perennial (1-5 years) shrub, (0.5-4 m). Altitude: unknown; mean annual temperature: 18-38 ºC; mean annual rainfall: 400-2500 mm. The major soils are alluvials, Vertisols and Alfisols, which range in pH from 5 to 7 or more. It is sensitive to salinity and has not been produced on saline soils. It is also susceptible to water logging.
Feronia limonia		x	x			x			x	x			x	x			A deciduous, slow-growing tree (unknown size). Altitude: below 0-450 m; mean annual temperature: unknown; mean annual rainfall: unknown mm. Throughout its range there is a diversity of soil types, but it is best adapted to light soils.

[28] Soil fertility – refers to species that increase the nutrient content of the soil (e.g. nitrogen fixing species).

Gliricidia sepium		x	x	x		x	x	x			x	x	x	x	x	x	A small to medium sized tree (2-15 m). Altitude 0-1600 m; mean annual temperature 15-30 ºC; mean annual rainfall: 600-3500 mm. Grows on a range of soil types from pure sand to deep alluvial lake-bed deposits. In much of its natural range the soils are acidic (pH 4.5-6.2); however, where parent material is limestone, the soils are slightly alkaline. It performs well on marginally saline vertisols but will not tolerate very acidic soils.
Jatropha curcas		x	x	x		x		x	x	x				x			A small tree (up to 6 m). Altitude 0-500 m; mean annual temperature 20-28 ºC; mean annual rainfall: 300-1000 mm. Grows on well-drained soils with good aeration and is well adapted to marginal soils with low nutrient content. On heavy soils, root formation is reduced. Also used as a bio-diesel
Leucaena leucocephala		x	x	x	x	x	x	x		x	x		x	x		x	A small tree (up to 5 m). Altitude 0-2100 m; mean annual temperature 25-30 ºC; mean annual rainfall: 650-3000 mm. Performs optimally on calcareous soils but can be found on saline soils and on alkaline soils up to pH 8; it is not tolerant of acid soils or waterlogged conditions. *L. leucocephala* is known to be intolerant of soils with low pH, low phosphorus, low calcium, high salinity, high aluminium saturation and water logging and has often failed under such conditions.
Pithecellobium dulce		x	x			x	x	x		x			x	x		x	A medium tree (10-15 m). Altitude 900-1800 m; mean annual temperature 0-48 ºC; mean annual rainfall: 250-1650 mm. Found on most soil types including clay, limestone, and wet sand with a brackish water table. The tree is rated highly tolerant to soil salinity and impoverished soils. It grows best on well-drained, deep, fertile loamy agricultural soils.
Sandaricum koetjape		x	x	x									x				A medium-large tree (up to 50 m). Altitude up to 1000 m, prefers podzolic soils in both humid and seasonal climates, prefers high rainfall but can tolerate dry seasons.
Sesbania grandiflora		x	x			x		x		x	x	x	x			x	A small tree (8-15 m). Altitude 0-1000 m; mean annual temperature 22-30 ºC; mean annual rainfall: 800-4000 mm. It can be grown on a wide range of soils including those that are poor and waterlogged. It tolerates saline and alkaline soils and has some tolerance to acidic soils down to pH 4.5.
Sesbania rostrata		x	x	x		x		x						x			A short-lived perennial (1-3 m). Altitude 0-1600 m; mean annual temperature unknown; mean annual rainfall: unknown. Occurs naturally in marshes, floodplains, on muddy river banks and the edges of pools, but has also been recorded in open savanna. It tolerates waterlogged soils and flooding to over 1 m deep. In cultivation, *S. rostrata* is usually associated with wet rice.
Tamarindus indica		x	x			x	x					x	x	x		x	A large evergreen tree (up to 30 m). Altitude 0-1500 m; mean annual temperature up to 47 ºC; mean annual rainfall: 350-1500 mm. Soil type: It grows in most soils but prefers well-drained deep alluvial soil.
Manilkara zapota		x	x			x			x				x				A large, evergreen forest tree (more than 30 m). Altitude 0-2000 m; mean annual temperature below 42 ºC; mean annual rainfall: 1250-2500 mm. Soils can be well-drained, slightly alkaline, medium-textured loams; however, *M. zapota* will tolerate a wide range of soil types from drier sands through to heavy clays with marginal drainage.
Dimocarpus longan		x	x									x	x	x		x	A small-medium sized tree (9-12 m). Altitude 150-450 m; mean annual temperature 15 ºC; mean annual rainfall: unknown. Thrives best on a rich sandy loam and nearly as well on moderately acid, somewhat organic, sand. It also grows to a large size and bears heavily in oolitic limestone. In organic muck soils, blooming and fruiting are deficient.
Acacia mangium		x	x	x		x		x			x		x	x	x	x	A large evergreen tree (25-35 m). Altitude 0-800 m; mean annual temperature 18-28 ºC; mean annual rainfall: 1500-3000 mm. Prefers deeply weathered or alluvial soils.
Azadirachta indica	x		x	x		x		x	x	x			x	x	x	x	A medium tree (15-30 m).Altitude 0-1500 m; mean annual temperature up to 40 ºC; mean annual rainfall: 400-1200 mm. It grows on a wide variety of neutral to alkaline soils but performs better than most species on shallow, stony, sandy soils, or in places where there is a hard calcareous or clay pan not far below the surface. It grows best on soils with a pH of 6.2-7.

Moringa oleifera		x	x	x	x	x	x		x	x	x	x		x		x	A small to medium tree (up to 10 m). Altitude 0-1000 m; mean annual temperature 12.6-40 ºC; tolerates rainfall as low as 500 mm per year. Adapted to a wide-range of soil types but does well in well drained clay or clay loam without prolonged water logging. Prefers a neutral to slightly acidic soil reaction, but it has recently been introduced with success in Pacific atolls where the pH is as high as 8.5.
Pinus merkusii	x			x				x	x	x			x	x		x	A large tree (50-70 m). Altitude: 0-2000 m; mean annual temperature: 21-28 ºC; mean annual rainfall: 1000-3500. Growing well on many different types of soil, such as sandy and red soils, and in varying climates
Acacia auriculiformis		x		x				x					x	x	x		A medium evergreen tree (15-30 m). Altitude: below 0 -1000 m; mean annual temperature:24-38 ºC; mean annual rainfall: 650-6000 mm. Found most commonly on clay soils, it exhibits the ability to grow in a variety of soils including calcareous sands and black cracking clays, seasonally waterlogged soils, sandy loams and coral rag. It can also tolerate highly alkaline and saline soils, pH ranging between 4.3 and 9.
Crotalaria juncea		x		x	x			x			x						An herbaceous, laxly branched annual, (1-3.5 m). Altitude: below 0-900 m; mean annual temperature: 9-30 ºC; mean annual rainfall: 170-200 mm. Found on light, loamy well-drained soils are preferred; on low-lying or clay soils it achieves vigorous growth. A pH of 5-8.4 is a suitable range.
Flemingia macrophylla	x			x	x	x		x				x	x	x		x	A woody, deep-rooting, tussock-forming shrub (1-4 m). Altitude 0-2 000 m; mean annual temperature: unknown; mean annual rainfall: 1100-2850 mm. Found naturally on both on clay and lateritic soils. The species has an outstanding adaptation to acid (pH 4.6) and infertile soils with high soluble aluminium (80% saturation). It can tolerate fairly long dry spells and is capable of surviving on poorly drained soils with water logging.
Peltophorum pterocarpum		x		x		x	x	x				x	x	x		x	A medium-large deciduous tree (15-24 m). Altitude 0-1600 m; mean annual temperature 22-32 ºC; mean annual rainfall: 1500-4500 mm. The tree prefers light to medium free draining alkaline soils although it also tolerates clay soils.
Ceiba pentandra		x				x	x				x	x	x				A large deciduous tree (60-70 m). Altitude: below 0-900 m; mean annual temperature: 18-38 ºC; mean annual rainfall: 750-3000 mm. Found on deep permeable, volcanic loam, free from water logging.
Erythrina variegata	x					x			x		x		x				A deciduous tree, 3-27 m. Altitude 0-1200 m; mean annual temperature 20-32 ºC; mean annual rainfall: 1250 mm. Occurs in evergreen and deciduous (dipterocarp) forest with a canopy varying from dense to open.
Khaya senegalensis		x				x			x	x	x		x	x			A medium deciduous evergreen tree (15-30 m).Altitude 0-1800 m; mean annual temperature 24-31 ºC; mean annual rainfall: 400-1750 mm. Tolerant to a wide range of soil conditions, from neutral to very strongly acidic and from very well-drained, coarse sandy loam to somewhat poorly drained clay. Prefers neutral, deep, sandy loam soil that is well drained. Such fertile conditions are often found in alluvial soils.

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