## OUTPUT: CONNECTIVITY IMPROVEMENTS FOR MEKONG RIVER ISLANDS

### A. Overview

**1. General.** The Royal Government of Cambodia (the Government) has requested financing from two agencies to implement the captioned output under the proposed Rural Roads Improvement Project II (RRIP II). These agencies are: (i) Asian Development Bank (ADB); and (ii) Nordic Development Fund (NDF).

2. This document describes, in detail, the activities envisioned under one of the five outputs of the main project: Connectivity Improvements for Mekong River Islands. The monitoring indicators of this output are shown in Section F.

3. The activities under this output are essentially intended for strengthening the accessibility of the Mekong River Islands. The output design also places emphasis on the importance of economic diversification and access to markets. This will, in effect, reduce social and economic vulnerability to climate shocks by securing mobility to the mainland Kampong Cham for trade, education and health care. Securing mobility will also enable access to critical services of schools and clinics. Through such activities, the planning capacity for climate-resilient infrastructure by the executing agency – the Ministry of Rural Development (MRD) – and provincial organizations will be enhanced for remote areas with limited connectivity. While data and information on global and regional climate change impacts are improving, it is still challenging to inform the design of engineered structures with precision, especially in Cambodia, where the lack of available climate change impact assessments and data adds to this uncertainty. However, several low risk options and no-regrets resilience measures such as piloting water capture and storage systems, planting appropriate species to restore ecosystem functions, and emergency management systems may be undertaken.

**4. Nordic Development Fund.** The Government is one of the first recipients of climate related financing from NDF for the road sector in 2010, for ADB-financed project Rural Roads Improvement Project.[1] In Loan 2670,[2] NDF financing was a $5.5 million equivalent grant, on parallel basis, to develop a pilot intervention in Southeast Asia the Climate Change Adaptation Output (CCAO). While CCAO is currently ongoing, its application has been substantial in Cambodia's road sector,[3] within MRD and to the Ministry of Public Works and Transport (MPWT). Loan proceeds of Loan 2670 designed the proposed RRIP II, under which the Connectivity Improvements for Mekong River Islands Output will receive a $5.4 million grant equivalent from NDF.

5. **Outcome and Outputs of the Proposed Project**. The outcome of the proposed RRIP II is a safe, climate resilient, and cost effective rural road network that provides all-year access in agricultural areas of the nine project provinces. The project includes improvement of about 729 kilometers (km) of rural roads in nine provinces (Banteay Meanchey, Battambang, Kampong Cham, Kampong Chhnang, Kampong Speu, Kampong Thom, Pursat, Siem Reap, and Takeo) to paved condition. The total project cost is about $118 million.

6. There are five key outputs in this project: (i) rural road improvements; (ii) rural road asset management; (iii) rural road safety and community awareness program; (iv) project

[1] ADB. 2010. *Report and Recommendation of the President (RRP) to the Board of Directors: Proposed Loan to the Kingdom of Cambodia for Rural Roads Improvement Project.* Manila (Loan 2670-CAM).
[2] Footnote 1.
[3] Lessons Learned (accessible from the list of linked documents in Appendix 2 of the RRP).

management support; and (v) connectivity improvements for Mekong River Islands. Adjustments in civil works based on climate risk assessment are integrated into output (i) and (v), with complementary soft measures fall under output (v) sub-output 2. This document describes output (v) in detail.

7. One good practice in an output of this nature is the inclusion of knowledge management activity.[4] The knowledge management activities are: (i) better understand how roads can be planned, designed, and maintained to cope with the negative impacts of climate change; (ii) better understanding of how roads may inadvertently increase vulnerability to climate change (the state of the roads where climate adjustments have been made will be monitored through the road asset management database of MRD); and (iii) lessons on institutional structuring for integrating climate resilience into infrastructure development projects and decision-making. Each of these is ongoing in Loan 2670 under CCAO; in this output, a separate team of consultants will not be necessary to assist. The project management unit (PMU) will be responsible for compiling these and feeding them into the country-wide learning mechanism. Additionally, the PMU will maintain a project-specific website with MRD's web to introduce all key reports, news events, and milestone achievements of the output. PMU will also organize a special session during the MRD Annual General Meeting (held in January each year) to focus on achievements and knowledge sharing on the output.

## B. Climate Change Impacts on the Mekong River Islands

8. **Overall.** Situated in the Mekong River in the east of Kampong Cham City, there is a cluster of 5 islands which are inhabited. There are nearly 30,000 persons living in the island cluster, which has approximately 6,900 households. The total population is sizeable, though the island cluster is rather isolated from access during natural calamities. A major natural disaster that hits the island cluster is flooding, which occurs during the rainy season each year. As shown in Table 1, there are about 15 casualties and 85 losses of livestock, on the average, recorded during past five years from 2008 to 2012, in the island cluster. While the loss of lives is due to disasters and lack of access during emergencies, loss of livestock, on which the residents' livelihoods are highly dependent, adds further burden on poverty level of the island residents.

**Table 1: Population and households of 2013 and Average Losses due to Flooding in the Mekong River Islands**

| Island | Population (households) | | Male | Female | Casualties[a] | Livestock Losses[a b] |
|---|---|---|---|---|---|---|
| Kaoh Mitt | 7,610 | (1,656) | 3,818 | 3,882 | Average total casualties due to emergency related access and floods: 15 persons/year | Average total livestock loss due to floods: 85/year |
| Kaoh Soutin | 10,925 | (2,761) | 5,356 | 5,569 | | |
| Kaoh Thmei | 1,637 | (413) | 803 | 834 | | |
| Kaoh Samrong | 7,256 | (1,445) | 3,516 | 3,740 | | |
| Kaoh Pir | 2,440 | (593) | 1,225 | 1,215 | | |
| **Total** | **29,868** | **(6,868)** | **14,718** | **15,240** | | |

[a] over the period from 2008 to 2012.
[b] only four-legged livestock; bird-types not included.
Source: Commune Statistics of Kampong Cham (2012–2013).

9. **Livelihood**. Residents of the island cluster are engaged primarily in farming of cassava, corn, peanut, tobacco, and other crops, such as fruits and vegetables. The residents are highly

[4] The proposed knowledge management activities are generally routine activities now, following the NDF intervention in MRD.

dependent on accessing markets on the mainland Kampong Cham to sell agricultural products. Their primary source of income is agriculture and, therefore, they are highly vulnerable to drought and floods damaging their crops. Few have savings to buffer against these losses and income diversification would greatly benefit their ability to withstand climate shocks.

10. **Services**. Some islands have one primary school but none have health care services. Energy needs are met by local entrepreneurs who have set up diesel generators and sell electricity to the population. Water supply and sanitation needs are met primarily by local wells and pit latrines which families have mostly built themselves, with the exception of a few larger wells which have been funded by local and provincial governments. Very few services are provided by the government, and the island community has become well organized for self-sufficiency. However, there are many limitations to this self-sufficiency. This type of energy provision is relatively expensive and highly reliant on diesel generation with its associated pollution. The quality of ground water is not regularly monitored and there is virtually no road rehabilitation or maintenance.

11. **Access**. Access to markets, schools, and medical services is insecure, and connectivity to the mainland and/or inter-island is critical, and is solely by boat during the rainy season. Residents of these islands use small motor boats from several small landing areas, which are not properly built for safe landing or launching, to cross the Mekong River to the mainland Kampong Cham. Each island has a main rural road, under the jurisdiction of MRD, that has been constructed from the village going towards the boat landing areas. However, road access and boat landing have become increasingly hazardous, especially during the rainy season and monsoons which have become increasingly intense in the area. Travel times during the rainy season have doubled, and this has placed additional burden and risks on villagers, with high fatality rate of patients being transported to mainland during serious illness or emergency (para 8). With an aging population, the slow and deteriorating access to health care services is expected to exacerbate the already tenuous health care issues for the local communities.

12. **Objective**. In this output, it is intended to reducing the vulnerability of the villages with improved accessibility and reduced risk to island flooding with water management. It is also intended to adopt climate change adaptation interventions of multi-sector nature for fully using the potential of sustainable resources in the island cluster. The output design also places emphasis on the importance of economic diversification and access to markets. This will, in effect, reduce social and economic vulnerability to climate shocks by securing mobility to the mainland Kampong Cham for trade, education, and health care. Reducing the reliance on agriculture will lessen the impact on the local population when floods or drought damage crop production. Securing mobility will also enable access to critical services of schools and clinics. Further, self-sufficiency of renewable energy generation in these islands is another area of focus.

### C. Sub-outputs and Activities of the Output

13. Based on the above overall approach, the following are two key sub-outputs in this output. The first is to design physical interventions that would increase island connectivity of the villages of the 5-island cluster in Mekong River to the impacts of climate change. The second is to establish strategic changes in multi-sector development of climate change studies and flood planning for enhanced access, agriculture, climate resilient tourism, and rural clean energy generation. It is expected that all activities of the first sub-output will serve as a basis for the signature interventions in developing strategic directions of the second sub-output.

### C1. Sub-output 1: Improved Climate Resilient Access

14. **Climate resilient island roads**. The climate resilient island roads are in line with the MRD policy for rural roads to provide all year access to all – access to basic needs, economic and social facilities, and services and opportunities (MRD, 2012). The goal is to develop and manage sustainable road transport infrastructure, modes, and services. It declares: (i) rural access will be efficiently developed and managed to ensure optimal economic returns on investment; connectivity to higher order infrastructure; benefits to society and the use of local resources; (ii) rural access will be sustainable in economic, environmental, and social terms; (iii) land and water rural infrastructure will be complementary to improve rural access for women and men; and (iv) rural transport modes and services will be equitable, affordable, dependable, and safe.

15. **Existing roads**. An inventory of the existing network shows that there are 67 km of island roads, of which the communes have paved 14 km in concrete over the years. The remaining are earth roads impassable during the rainy season. There are also 33 small bridges and culverts.

16. All the roads are managed by MRD, and all of them provide access from commune to village, village to village, or to a jetty, and are, therefore, defined as Category 4 in the MRD administrative inventory.

17. The paved roads are all hand-laid cement concrete, in various conditions. Many are in good condition. For different roads, their individual width varies from 2 meters (m) to 5 m. They have been constructed by hand using natural gravels and sands as aggregates, both obtained from the Mekong River. Overall, cement concrete roads are a sensible technical solution for the development of roads on the islands, especially because the roads are expected to be subject to annual flooding. Although the Mekong River water level varies annually by approximately 8 m and channels between the islands fill with river water, the villages are generally located on higher land and the floods they experience are caused by rain water (not fast flowing river water). Flood waters subside after a few days. Although flooding makes the construction of durable roads more difficult, it is part of the natural annual cycle, and is an important source of water for agriculture and domestic use.

18. **Drainage**. The condition of the cross drainage structures, including small bridges, is variable but generally insufficient or not functioning. Most of the structures need to be replaced and, in order to achieve connectivity throughout the individual islands, the structures will be replaced on all roads, except those are in a good condition.

19. **Bridge connectivity from mainland**. Kaoh Mitt is served during the dry season by a long bamboo bridge, with an earth road approach on the mainland within Kampong Cham City and a bamboo road on the island. The bridge is capable of carrying heavy 4-wheel drive cars and light trucks. It is mostly used by pedestrians and motorcycles. The traffic over the bridge is considerable, over 5,000 passenger car units per day. Many people appear to be commuting to Kampong Cham City. This bridge is removed during the wet season and is put back when the water recedes. The bridge connects to a long bamboo road over the sands, which is exposed when water levels are low.

20. Approximately 1 km to the east of the bamboo bridge, a new permanent bridge is under construction by MPWT to connect Kaoh Mitt to the mainland. The new bridge will be 9.5 m wide and approximately 795 m long. On the mainland, the bridge connects to an existing road, but

apart from a short (50 m) widened bridge approach road, made of engineered earth, on Kaoh Mitt, the bridge only connects to a little-used track which, after a short distance, connects to an earth road 5 m wide. The bridge is expected to be completed in late 2014, but this is not definite. The new bridge dominates concepts of connectivity for Kaoh Mitt, and also for Kaoh Soutin and Kaoh Thmei. Therefore, access to the bridge on the Kaoh Mitt side must be improved. Some heavier truck traffic may be expected to use the bridge and this may generate benefits to the islands in general. Based on this, this sub-output has designed road improvements in the islands to maximize these benefits.

21. **Improved jetties**. Each island has a number of jetties from where access is provided to the mainland, or to another island. Some are for use during high or low water levels; a few are suitable for use during both seasons. The ferry operators move their services to different locations depending upon the water levels. The ferry boats vary considerably in size and shape as some are capable of carrying up to 4 heavy-duty cars or small trucks. They can carry numerous motorcycles and animals. Some ferries appear quite new being of steel construction, others are older wooden construction. Those capable of carrying motorcycles or bigger vehicles have front loading ramps which can be raised or lowered for loading and/or unloading. These types of ferries require an approach road, not a floating or fixed jetty.

22. Where the jetties are located on steep river banks, either on the islands or on the mainland, the jetty is not sufficiently durable; with only a steep, shaped earthen approach which is easily damaged with physical use or rainfall and can become unusable.

23. At many locations on the islands where the river is shallow during the dry season, a long stretch of usually sandy riverbed is exposed and the ferries cannot reach the island. They offload at the water's edge and the vehicles and people have to traverse a long stretch of several hundred meters. Sometimes bamboo-mats are provided to make these lengths passable. These lengths of riverbed make connectivity very tentative or impassable after rainstorms. The bamboo-mats are a simple construction, but quite durable, being a simple cross matrix of sliced lengths of bamboo cut and made by hand into a 3 m square mat. It is light-weight and simply laid end-to-end on the sand.

24. **Jetty ownership**. The jetties are publicly-owned and are under the management of the Governor of the Province of Kampong Cham. Ferry services are provided by private owners; they bid annually to provide the service and to maintain the existing jetties. The same system is used for provision of the bamboo-mat roads. A toll is charged for the bamboo bridge, bamboo-mat roads, and the use of ferries or boats.

25. **Private sector participation**. Private sector participation in boat services will continue, but needs to be regulated by MRD, in coordination with the provincial authorities, once these proposed roads and jetties are constructed under the project. A Memorandum of Understanding needs to be signed with the Governor's Office to define the regulations and responsibilities.[5] The private boat operators will need to improve their services, fees, safety, and time tables, while maintaining operational efficiency for operations by the private sector. This will ensure sustainability of the newly provided infrastructure.

26. **Island connectivity.** For connectivity to be improved, at least one durable road must connect to a durable jetty from where a boat or ferry service connects to another durable jetty, including those on the mainland. Kaoh Pir and Kaoh Samraong require connectivity for at least

[5] RRP, Item IV, para. 37.

some social services to another destination, closer than Kampong Cham City. Except for Kaoh Soutin, the islands do not have high schools and students travel to the mainland to study. For Kaoh Mitt, and as much as possible, for Kaoh Soutin and Kaoh Thmei, good connectivity means that the improvement of roads and jetties will provide a continuous durable link to the new bridge. It is expected that the bamboo bridge and seasonal jetty-based services to the north will no longer be required.

27. **Technical Standards.** Over recent years, various programs have introduced standards for rural roads. One recent and well-founded program with MRD was the South East Asian Community Access Program (SEACAP, 2009). International rural road geometric design standards were reviewed and a set proposed. These are based on sound engineering rules and practice, and consider geometrics from a road usage and road safety perspective. They define five technical classifications for the rural roads in Cambodia that take traffic type and volume into account. The standards include limits for the other parameters required for geometric design. The designs will be adapted for the islands where necessary. The current low speeds on the concrete roads of 25 km per hour will be maintained. Average travel time savings will be achieved by increasing speeds on the currently unpaved sections. These low speeds are quite sufficient for the lengths of the typical journeys because the islands are relatively small. Road roughness will be reduced to acceptable levels which will produce road user savings and greatly reduce the discomfort especially for elderly people and those who are unwell. These low speeds should ensure high levels of road safety. Nevertheless, good signage and traffic calming measures will be designed to ensure good road safety standards are maintained.

28. **Road design**. The design vehicle for the road improvements is a small truck, of similar dimensions as a large 4-wheel drive vehicle, with an overall width of 2 m and a length of 4 m. Suitable widths are 5 m for a two lane road (25 km per hour passing speed), and 3 m for a single lane road which carried less traffic. Passing places will be provided at suitably frequent intervals along sections with an adequate line-of-sight. These dimensions are consistent with SEACAP.

29. **Pavement Design**. Actual road usage was taken into account for road pavement design. While earth or gravel surfaced roads (laterite) are commonly used, they are not suitable on the islands. Conditions are seasonally too wet for earth roads, and they are erodible. Laterite is not locally available, and it is too difficult and expensive to haul, therefore, only a low quality material is available. The residential communities are predominantly spaced along the road sides and dust will be a hazard if unpaved roads continue to be used. Flexible paved roads are unsuitable because of the machinery and materials used to construct them, and because there is a risk of flooding. Thus, hand-laid concrete roads are the obvious choice, which has been proven by the existing paved roads. Pavement thickness design is important, and SEACAP pavement designs for concrete roads for low volume traffic have been adopted in the basic design here.

30. The use concrete with a hydraulically-bound or stabilized materials support layer is suitable for Cambodia generally. Thus, local materials can be stabilized including the existing road materials, and for the island roads, the layer required is quite thin (75 millimeters [mm] to 100 mm). The mixing can be carried out in place or with the small-scale cement mixer used for road concerting. Compaction is achieved by hand-held machines, plate, or drum compactors. Stabilized support layers (sub-bases) are resistant to the effects of flooding and climate change, and greatly improve the durability of the concrete. Therefore, the whole road improvement process is highly labor based with high potential for income generation for island residents, especially women.[6]

[6] Gender Action Plan (accessible from the list of linked documents in Appendix 2 of the RRP).

31. The following considerations for climate change adaptation have been taken into account with a design sustainable for a 100-year flood. The pavement design is a 150 mm concrete pavement laid on a stabilized sub-base consisting of reprocessing the existing local soils with small proportions (approximately 4% by weight of soil) of either cement or lime, whichever is the most technically suitable for the local soils. The sub-base will be cured before the construction of the overlying concrete pavement.

32. **Levees and water management**. Apart from the aforementioned climate resilient roads and jetties, levees and water management interventions, though minor in scale, will be designed during the detailed design stage, that would eliminate the risk of flooding due to rain water. Levees have been constructed in the past to contain surface runoff water or to retain water from the Mekong River when it is in flood for use during the dry season. At the same time there should also be drainage channels to prevent overflowing of the storage areas in an uncontrolled fashion especially into populated areas. If this cannot lead to other storage ponds at a lower level then it should flow into the Mekong River. The cause of flooding in and around the populated areas may be likely due to rainfall only as the land in these areas is above the maximum flood levels of the Mekong River. It is also quite possible that levees are poorly designed or are damaged or missing in populated areas. Therefore, the improvement of levees is necessary with a simple design during the detailed design stage.

33. Levees are a simple construction using locally available clayey soils which because of the clay content have a low permeability to water and are less erodible than sands. Material usually designated for low quality embankment use is suitable. Materials can be extracted from the existing local water reservoirs when they are dry which will, of course, increase their capacity as dry season water sources. The levees should be grassed to further increase their resistance to erosion and where necessary the levees can be faced with harder materials such as bagged mixtures of soil with the technically suitable stabilizer, effectively hardened sandbags which are commonly used for flood protection. Grass should also be grown between the hardened sandbags to give additional long-term durability.

34. While the levees will reduce the stagnating water in the island, as explained above, water storage reservoirs may enhance water management as they assist proper draining during rainy season and could be pumped to higher ground with solar pumps for irrigation and animal feeding during the dry season. All these minor interventions are included in the civil works contract package under this output, as of para. 36.

35. The total length of roads to be improved for climate resilient concrete paved design with drainage and water management will be 50 km in the islands. The total number of jetties to be improved for durable all-year access will be 11, of which 4 are in mainland Kampong Cham. The average unit cost of roads, including one 350 m bridge connecting two saddle points within Kaoh Soutin (which is inundated by river water cutting the island into 2 halves), and drainage structures is approximately $153,000 per km. Jetties are about $168,000 each, which have the similar design for all types of vessels that are currently operating for Mekong River passenger traffic. Equipment for jetties include: floating pontoon at each jetty and jetty equipment with a small lockable store house, and hardware to adjust the floating pontoon battery storage area for the solar lighting for the jetty.

36. **Civil Works Contract Package**. The islands are closely geographically grouped a few km either north or south of Kampong Cham City, and three are actually connected by land (travel) during the dry season. In view of the civil works costs and the geographical proximity,

only one civil works package is proposed for both the road and bridge works, and the improvement of the jetties. The costs will attract international firms in associating with national contractors and its magnitude will permit economies of scale without overloading supervision costs for either the detailed design and implementation supervision (DDIS) consultants or the PMU of the executing agency.

### C2. Sub-output 2: Climate Change Adaptation Framework

37. **Overall.** Climate change is relevant to this sub-output in two ways. With respect to island interconnectivity in particular, changes in climate parameters (i.e. future rainfall patterns), as well as current climate patterns, reduce access and mobility of the transportation network. Flooding is an obvious problem, but extended drought during the dry season is also experienced regularly. Transportation infrastructure must, therefore, be designed for both of these stressors to the transportation network, including land and water based transport. Addressing intermodal transport will be an innovative aspect of this project.

38. Further, as small islands in the midst of the seventh longest river in Asia, the populations are highly vulnerable to fluctuations in water levels, as well as to changes in precipitation patterns. Because of their manageable size, the locations provide an opportunity to develop more integrated multi-sectoral adaptation planning, with the objective of developing models for development based on better planning for future climate conditions. Because the populations are almost entirely dependent on natural resources for their livelihoods, they are extremely exposed to changes in climate, which affect things like agricultural productivity. Because these are islands, maintaining access to an inter-island transport network during flooding is crucial to maintaining livelihoods, such as bringing products to markets, and accessing schools and clinics. Thus, transport planning must draw from an understanding of how, why, and where people move to support their livelihoods. Climate change presents an additional stress to increasing quality of life in these vulnerable islands.

39. Climate change will, therefore, be addressed through this output in two ways: first, by informing the design of the transport infrastructure (sub-output 1), and secondly, by providing support to reducing current and long-term livelihood vulnerability through multiple sectors. The multi-sectoral adaptation approach has been organized into an adaptation framework for the five islands (sub-output 2).

40. **Adaptation Framework Objectives.** The adaptation framework proposed seeks to support the strategic directions identified in MRD's draft Strategic Plan of Rural Development for Climate Change Adaptation in Cambodia (SPRD-CCA).

41. The strategic directions in the draft SPRD-CCA, and those of this framework, include: (i) ensuring transport mobility and access to critical services during extreme events, particularly floods; (ii) ensuring safe access to water during climate extremes, such as drought; and (iii) ensuring sustainable and diverse rural livelihoods to reduce vulnerability to climate change.

42. The framework will include a focus on reducing the vulnerability of women and the poor, as these are vulnerable populations in the project area, and to climate change impacts. The proposed framework developed under this Output was designed alongside these strategic directions and identifies a number of projects that contribute to its implementation.

43. The transport network and other infrastructure play a central role in the economic functioning of the country, and determine the location and continuing productivity of many other

development investments. However, the transport sector also often suffers some of the highest direct physical losses, with far-reaching indirect consequences. The direct losses often receive particular attention in damage, loss, and needs assessments, but the implied toll on the population is less frequently reported (ADB, 2013).[7]

44. These indirect impacts can take the form of disruptions to the movement of goods and services, reduced access to schools and health-care facilities, prolonged travel times, increased transportation costs, or reduced competitiveness, all of which can result in particular hardship for lower-income households. This toll is often exacerbated by substantial delays in securing funding for reconstruction, and by the reallocation of transport maintenance and investment resources to early recovery and reconstruction, thereby reducing the quality of unaffected sections of the transport network and delaying planned extensions (ADB, 2013).

45. **Methodology for Designing the Adaptation Framework.** The adaptation framework has been developed based on the three strategic directions of climate change adaptation, planning as identified by the Intergovernmental Panel on Climate Change: vulnerability, impacts, and adaptation. It is a useful method for ensuring that information collection is targeted to the needs of adaptation planning, which is the ultimate objective. The results of each are found in the following paragraphs.

46. **Impact assessments**. These are often modeling-based and seek to identify the impact that changes in climate will have on systems. These can be biophysical, such as impacts on hydrology or forest cover, or socioeconomic, such as human migration patterns or food production. In this case, maps were produced by Loan 2670 (CCAO) to illustrate flood patterns on the islands.

47. **Vulnerability assessments.** These are used by many fields of expertise and can rely on a limitless number of variables. Their objective is to understand the effects of a hazardous event on a given subject. For example, one can study the effects that sea-level rise will have on agricultural production. Here, two lines of vulnerability assessment will be followed: (i) the vulnerability of the transport systems to floods, and (ii) the vulnerability of livelihoods to climate stresses. These two analyses merge towards an adaptation assessment. This is essentially the identification of a solution or a set of solutions over time to reduce the negative effects of climate change and, to take advantage of any opportunities that may arise. The decision-making sciences enter into work here, and much of the latest thinking on adaptation in the infrastructure sectors.

48. **Climate Change Vulnerability Profile for five Islands.** Managing risk and uncertainty, which is inherent in adapting to future climate changes, can usefully be addressed by applying risk management principles. *Hallegatte* suggests designing flexible adaptation strategies for infrastructure,[8] and Mathew et al. adds that local governments should choose soft, short-term and/or reversible options with co-benefits.[9] Giordano recommends the use of “adaptive policies” which is “devised not to be optimal for a best estimate future, but robust across a range of plausible futures”. [10]

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[7] ADB. 2013. Investing in Resilience, Ensuring a Disaster Resistant Future.

[8] Hallegatte, S. 2009. Strategies to adapt to an uncertain climate change. *Global Environmental Change*. 19, pp. 240–247.

[9] Mathew, S.; Truck, S.; Hendersen-Sellers, A. 2012. Kocki, India case study of climate change adaptation to floods: Ranking local government investment options. *Global Environmental Change,* 22, pp. 308–319.

[10] Giordano, T. 2012. Adaptive planning for climate resilient long-lived infrastructures. *Utilities Policy,* 23, pp. 80–89.

49. From a livelihoods perspective, communities may become less vulnerable to climate change when their savings are increased and their sources of income are diversified. This is already taking place with young people moving to the city to find other types of employment and sending remittances back home. At the same time, the exodus of the working age population can reduce the vitality of the local economy. Also, rural-urban migration is not always a positive development, and the rural economy remains important to Cambodia's economic growth.

50. Resilience is also increased when populations are healthy and have access to education, which is positively related to human resilience as their options and knowledge are increased. Continued access to these critical supporting services during climate stresses is essential to increasing the long-term resilience of the population. This is also the case when incomes are dependent on a single source of agricultural output, which is the case in the project area. Losing a crop because it cannot be transported during high water levels or irrigated during a dry period can mean a total loss of annual income. With little savings or other employment to depend on in these cases, the cycle of poverty deepens.

51. The following assessments were undertaken to understand the climate change challenges to livelihood development: (i) initial consultations with commune leaders; (ii) surveys of 308 individuals together with Social Survey; (iii) focused gender consultations; (iv) sector and partnership research (agriculture, energy, micro-finance, tourism and water); and (v) historical and projected flood patterns ongoing from CCAO. Based on the foregoing, this sub-output of Climate Change Adaptation Framework has the following 4 key activities.

52. **Activity 1: Income Diversification for Climate Resilience.** The objective of this sub-output is to increase the resilience of local livelihoods against climate variability and change.

53. The local economy is currently almost exclusively reliant on agriculture for income, and on limited varieties of cash crops, dominated by tobacco. Further, few people have savings which can be used to buffer them against losses from climate events. For example, one of the top concerns for individuals during floods and drought is a lack of food. A lack of cash to invest in higher education limit the ability of villagers to break the cycle of poverty, increasing their vulnerability and their environment becomes increasingly challenging.

54. Some local tourism exists, but the islands benefit little from these visits as spending does not take place on the islands by tourists, in part because the tourism services are lacking. Increased demand for socially-conscious tourism exists and the islands are aesthetic, and so could attract a niche market. However, little is known about the true tourism potential and market that exists. For example, one of the current draws to the islands now is the bamboo bridge in Kaoh Mitt, which will likely be abandoned once the new bridge in constructed further downstream. This may reduce the draw to the island. A better understanding of the profile of the potential tourist and the demands, such as restaurants, guesthouses, and activities, is needed before undertaking such a venture. Therefore, a market study is proposed, in line with any form of business development activity. The focus will be on environmentally and socially friendly activities.

55. Villagers interviewed, including commune leaders and women, had few ideas outside of agriculture for income generation. Further, people are skeptical of the success of small businesses and are lacking capital required. In addition, asking people to engage in new businesses in highly risky for them, and so must be supported technically, must originate from them, and be incrementally and gradually developed based on existing capacities. These are important to sustainability of income generation activities. A multi-year local entrepreneurship

training and support program is, therefore, proposed to enable locally-generated small business ventures. This will be accompanied by a contest and investment award for small business proposals by communities. A balance on gender and youth will be applied as a criteria. Proposals must also provide added value to existing income generating activities, be environmentally friendly, and resilient to climate change impacts.

56. The major tasks to be implemented are: (i) community based tourism potential assessment; (ii) entrepreneurship and small business development study and training program, focusing on women and youth. These could include vocational training, field-based training and site visits; (iii) development of MRD credit and awards program for climate resilient small business development proposals; and (iv) small business operations support program.

57. **Activity 2: Improving Water Access and Reducing Vulnerability of Agriculture to Climate Change.** Of those who practice agriculture, crop loss takes place during both floods and drought periods, and quantity, either too much or too little water, is the main challenge. This may be exacerbated through climate change, and so putting measures in place to manage these challenges now will help manage future impacts. Reducing the cost of irrigation through solar pumps in Activity 3 below will increase affordability and, therefore, access for all. Further, it will reduce the burden of hand-carrying well water, thereby freeing up more time for other livelihood development activities.

58. Some of the causes identified for food shortages include the fact that the local agriculture is dominated by cash crops. Vegetable growth exists but is limited due to land, time, and water shortage. Women have also said that their previous attempts produced poor quality products. There is also no rice production on the islands, though some cassava and corn is grown, but mostly for sale on the markets. With little savings, crop loss due to either floods or drought means that there is insufficient income for people to purchase food, or to trade their agricultural products for food. By increasing other sources of income from non-climate dependent activities, and reducing operating costs, households will be able to save more money for an emergency.

59. This sub-output will focus on physical measures to divert and store excess water during the rainy season, reducing cross losses. It will also pilot micro-irrigation systems to reduce water consumption during the dry season. Water user groups will be established in each project area. The group committees will be responsible for managing the collection of tariffs and managing the overall system. The committee should be representative on the population demographics.

60. The major tasks to be implemented are: (i) construction of drainage canals in lowland areas to reduce flood damage during rainy season; (ii) pilot efficient micro-irrigation; and (iii) pilot solar pumping systems for irrigation during drought periods.

61. **Activity 3: Income through Renewable Energy.** Household energy needs are for cellphone charging, lighting, and televisions. The largest expense for income-generating activities is diesel for irrigation and fertilizer inputs. Energy costs are relatively high on the island because they are not connected to the grid, because of their remoteness, and because of a lack of economy of scale for small local producers. This sub-output will focus on reducing the cost of energy for household and agricultural activities, thereby increasing savings so that individuals have greater protection against a subsistence way of living. Current small-scale solar systems cost $15–$25 per unit, or less when group purchased. A group purchase can be supported through a dedicated micro-credit scheme, building on existing successful programs run by the MRD.

62. At the same time, improved irrigation was named as the number one solution to managing changes to the rainy season and extended dry periods. A pilot introduction of solar-powered pumping systems, for which the technology exists in Cambodia, will be introduced. Unit costs are approximately $3,000 and above and, therefore, out of reach for these communities. The MRD can make an important contribution in this way.

63. This sub-output will, in particular, reduce some of these barriers by beginning as a pilot phase in order to increase awareness, reduce initial capital costs through group buying, offer rent to own systems, provide technical support and training, and involving current local energy providers.

64. The major tasks to be implemented are: (i) detailed assessment of renewable energy potential and most appropriate technologies for local conditions; (ii) create rent-to-own program, in cooperation with the private sector, for group-buy small-scale solar home systems or rent-to-own program with technical support, warranties, and replacement parts; (iii) install solar lighting systems for ferry landings to increase length of operating times and increase safety, as well as for emergency response stakeholders; and (iv) train local youth and current energy suppliers to repair and maintain solar systems.

65. **Activity 4: Improved Health and Safety during Climate Extremes.** The primary concerns for communities during floods are lack of food, lightning strikes, snake bites, and stomach problems. During the dry seasons, the main health problems include lack of potable water, lack of food, and stomach problems. This output will put in place measures to reduce impacts on human health, and assume that climate change may increase the intensity and duration of these two hazards.

66. Approximately 50% of the population on the islands has sanitation of any kind. This may be one source of health problems experienced by many. Overflowing of existing latrines and movement of human waste into the drinking water supply is one of the more common side effects of floods. Increasing sanitation coverage by constructing elevated latrines and elevated ring wells to avoid wastewater overflows may reduce the spread of disease. For the same reasons the clinics or commune leaders, in the case of Kaoh Pir, should be equipped to distribute water purification tablets when needed. The need for clean potable water is especially evident in Kaoh Pir, based on surveys and gender consultations. Water filter systems are needed as a replacement for a water and sanitation system that would, otherwise, be provided by government as a service to the population. Lack of food during climate extremes will be addressed by creating emergency supplies. In addition, reduced household and agricultural operating costs should provide individuals with more savings to purchase food when crops fail.

67. The main concern that people have in getting to hospitals during emergencies is that the hospitals are too far, that they are unsafe, and that they do not have transport. A minimum of 90% of respondents identified concerns with hospital access for emergencies. The issue of distance is especially acute for Kaoh Pir where pregnant women will move to stay near the hospital a month before delivery because of the uncertainty. While this output cannot construct hospitals, it can create time-savings through improved mobility. This will take place by creating the physical infrastructure but also by providing emergency speedboats and vehicles (identified as a priority over boats in Kaoh Pir). The commune leaders have offered to reserve community development funds to manage the operations of the emergency transport, including fuel costs.

68. The major tasks to be implemented are given below, which amounts to about $3.6

million cost including consulting services and investments proposed: (i) awareness program and emergency response plan including services safe areas for humans and animals; (ii) sanitation training program for reducing health risks during floods and drought, and increased sanitation with raised latrines and ring-wells in flood prone areas; (iii) provide water purification tablets to clinics for distribution; water filters distributed for potable water; and (iv) supply multi-purpose emergency hospital access and emergency response. A committee needs to be developed to include a prioritized list of uses for the boats and its utilization will be accountable to an established committee.

69. **Activity 5: Inclusive-growth Strategy for Rural Roads.** This activity aims at formulating a proposed inclusive growth strategy for rural roads in a multi-sector approach. Here it is important to involve local communities to formulate the strategy which expands beyond the implications for the rehabilitation and climate-resilient upgrading of existing roads. Fundamentally, further working with rural communities the Activity 5 may be able to develop a local rural road strategy that responds to the priorities of the various interests and sectors involved, presumably with agriculture and the implications of future climate change for such sector being identified as the top priority in the proposed strategy. Such a strategy may include considerations of new road routing and/or traces as well as physical design that has to be climate resilient.

70. Although the investments are concerned, this aspect may be beyond the scope of the project or this output, as a lengthy social analysis has already been conducted in the island cluster, this might provide an opportunity to develop at the micro level an approach to systematically involve local interests in more strategic aspects of rural road planning. The Activity 5 requires a relatively low cost to develop as a consulting work, but may be envisaged as potentially important by-product of the overall output or the project as it would be aimed at developing a general approach for integrating rural road planning into longer term climate adaptation strategy, particularly as it applies to agriculture sector. Special attention might be given to how to harness the expertise and priorities of local communities and farmers' organizations, and develop their own awareness and ability to work effectively with the MRD and other related government agencies. Overall, the Activity needs to develop the building blocks for more general strategic policy aimed at improving rural road networks in light of the sector/social implications of climate change.

71. Therefore, this activity requires sociological expertise – particular related to community organization – therefore, the national social development specialist proposed to develop this Activity 5, has to obtain guidance/support from the detailed design and implementation supervision consultants' international social development specialist and SEO.

## D. Cost Estimate

72. The cost estimate of the output is shown in the table below, based on sub-outputs and activities and the financing source. Tables 3 and 4 show the detailed cost estimates.

**Table 2: Output Cost Estimate**

| Item | Cost ($)[1] |
|---|---|
| A. Sub-output 1: Civil works of road and jetty improvements: contract package CW 6 (including levees, and water management structures) *(A: fully financed under ADB)* | 11,490,000 |
| B. Sub-output 2: Climate Change Adaptation (CCA) Framework | 1,739,300 |
| Activity 1: Consulting Services (CS5): CCA Framework Design and Impl. | 1,872,700 |
| Activity 2: CCA Framework of Investments *(B: fully financed under NDF)* | |
| **Sub Total** | **15,102,000** |
| C. Proportion of project management support by DDIS consultants for A, D *(C: $588,000 financed under NDF, remainder financed under ADB)* | 1,299,000 |
| D. Green planting under CW 10, CW 11, CW 12 *(D: $1,000,000 each financed under NDF and ADB)* | 2,000,000 |
| E. Financial charges on NDF Grant *(E: fully financed under NDF)* | 250,000 |
| **Total A+B+C+D+E** | **18,651,270** |

CCA = climate change adaptation, CS = consulting services, CW = civil works, DDIS = detailed design implementation and supervision, GPS = global positioning system, MPWT = Ministry of Public Works and Transport, NDF=Nordic Development Fund.

[1] Including contingencies but not including taxes and duties, which are paid by the Government.

Source: Asian Development Bank.

**Table 3: Consulting Services for CCA Framework Design and Implementation**

| Item | Cost($)[a] |
|---|---|
| 1. Consultants | |
| a. Remuneration and Per Diem | |
| i. International Consultants (28 person months) | 460,000 |
| ii. National Consultants (66 person months) | 219,500 |
| b. International and Local Travel | 31,400 |
| c. Reports and Communications | 5,000 |
| 2. Goods and Equipment (Solar, micro-irrigation, water filters, covered wells, navigation solar, emergency mobile units) | 370,000 |
| 3. Training, Seminars, and Conferences | 30,000 |
| 4. Surveys and data acquisition | 46,000 |
| 5. Miscellaneous Administration and Support Costs | 12,400 |
| 6. Civil Works (drainage, raised latrine construction) | 200,000 |
| 7. Micro-finance facility | 200,000 |
| 8. Sub-contracts under international firm (tourism potential study, entrepreneurship, renewable energy potential study) | 165,000 |
| **Total** | **1,739,300** |

[a] including price and physical contingencies, but excluding government taxes.

Source: Asian Development Bank.

**Table 4: CCA Framework of Investments**

| Subsector | Investment Type | Indicative cost ($)[a] |
|---|---|---|
| 1. Energy | River micro turbines, windmills, solar power | 200,000 |
| 2. Water | Drilling wells, sanitation facilities in public facilities | 300,000 |
| 3. Tourism | Eco-village concept interventions | 350,000 |
| 4. Agriculture | Micro-financing for cash crops | 300,000 |
| 5. Health and emergency services | Emergency management, boats and warning equipment, health center | 722,700 |
| **Total** | | **1,872,700** |

[a] including price and physical contingencies, but excluding government taxes.

Source: Asian Development Bank.

## E. Implementation Arrangements

73. As summarized in Table 5, it is envisaged that 28 person-months of international consultants and 66 person-months of national consultants will be needed to complete the tasks of the sub-outputs. The consultants will design a series of small interventions of investments in adaptation framework and implement them.

**Table 5: Summary of Consulting Services Requirements**

| Consultants | Task Contribution | Person-months |
|---|---|---|
| **International** | | |
| Team Leader/Rural Development Expert | Activity 1, 2, 3, 4, 5 | 8.0 |
| Irrigation Engineer | Activity 2, 3 | 6.0 |
| Renewable Energy Expert | Activity 3 | 7.0 |
| Rural Health and Sanitation Expert | Activity 2, 4 | 7.0 |
| Subtotal | | 28.0 |
| **National** | | |
| Rural Energy and Economic Development Expert/Deputy Team Leader | Activity 1, 2, 3, 4, 5 | 20.0 |
| Climate Change Adaptation Expert | Activity 1, 2, 4 | 5.0 |
| Micro-finance Expert | Activity 1, 2, 3 | 5.0 |
| Agriculture Specialist | Activity 2, 3 | 14.0 |
| Emergency Medical Logistics Coordinator | Activity 3, 4 | 12.0 |
| Social Development Specialist | Activity 2, 3, 5 | 10.0 |
| Subtotal | | 66.0 |
| **Total** | | **94.0** |

Source: Asian Development Bank.

74. Outline terms of reference for the experts are as summarized in Table 6.

**Table 6: Outline Terms of Reference of Consultants**

| Consultants Team | Activity/Tasks | Academic Qualifications and Years of Experience | Project Related Abilities |
|---|---|---|---|
| **International** | | | |
| Team Leader/Rural Development Expert | Overall project implementation, Activity 1 focus | Advanced degree in sustainable development, rural economic development or related fields. Ten years previous experience as a team leader. | Knowledge of climate change challenges in Southeast Asia, expertise in rural economic development and livelihood development. Experience in Cambodia is an asset. Ability to foster team-work and human resource management. Proven ability to work with government and international financial institutions. |
| Irrigation Engineer | Activity 2 | Advanced Engineering degree and eight years working on implementation of large and small-scale irrigation infrastructure in Southeast Asia. | Experience working in flood prone areas and small-scale agriculture. Experience in identifying and implementing efficient micro-irrigation and exposure to renewable energy technologies for agriculture. Experience working in rural Cambodia or Southeast Asia. |
| Renewable Energy Expert | Activity 3 | Advanced degree in studies related to energy development with a particular emphasis on renewable energy technology and energy operational management. Eight years' experience working in developing countries. | Knowledge of previous experience and challenges in implementing renewable energy projects. Experience with small-scale renewable energy technologies in addition to institutional arrangements for its implementation and long-term operations and maintenance. |
| Rural Health and Sanitation Expert | Activity 2, 4 | Advanced degree in public health policy and management, environmental health related to water-borne illnesses or disaster risk management and health. Minimum eight years field experience in developing countries. | Knowledge of the impacts of climate change on health, experience in developing and operating emergency response plans. Experience working with multiple emergency response and rural health responders. |
| **National** | | | |
| Rural Energy and Economic Development Expert/ Deputy Team Leader | Overall; Activity 3 focus | Academic background relate to energy development, particularly renewable energy. Strong written and verbal English and Khmer communication skills. Minimum twelve years' experience working on development projects. | Experience overseeing and fostering team-work, communicating with local stakeholders and ensuring timely delivery of project milestones. Experience working in the procurement, deployment and technical backstopping to renewable energy projects in rural Cambodia. |
| Climate Change Adaptation Expert | Activities 1, 2, 4 | Background in environmental sciences, studies and/or climate | Knowledge of the impacts of climate change on Cambodia, methodologies and best practices in |

| Consultants Team | Activity/Tasks | Academic Qualifications and Years of Experience | Project Related Abilities |
|---|---|---|---|
| | | change specific studies. Minimum five years working experience. | adaptation. Experience in development and implementing activities seeking to reduce vulnerability to climate change impacts. |
| Micro-finance expert | Activities 1, 2, 3 | Advanced degree in economics with some specialization in finance or agricultural economics. Minimum five years working experience. | Experience working in rural economic development, small-scale business development activities and tourism development would be an asset. Network with private sector and nongovernment organizations operating in Cambodia is needed. |
| Agriculture Specialist | Activities 2, 3 | Degree in agriculture, rural development, ecology or related field. Studies related to hydrometeorology and climate change a strong asset. Minimum eight years working experience. | Knowledge of climate change impacts on agricultural production in Cambodia. Experience in implementing construction and especially community management on irrigation schemes needed. Experience in disaster risk management for farmers' needs required. |
| Emergency medical logistics coordinator | Activity 3, 4 | Degree in public health and safety and emergency response planning or applicable fields of study. Minimum eight years working experience, especially in rural areas. | Experience working with emergency first responders to develop and implement response plans together with communities. Knowledge of main risks and preventative measures for human and economic losses from extreme events. |
| Social Development Specialist | Activity 2, 3, 5 | A degree in social development disciplines with experience in agriculture related social aspects. Minimum eight years working experience. | Experience working in rural areas of Cambodia where small-scale agriculture is predominant. Experience working in the road sector in addressing needs of social aspects is also necessary. |

Source: Asian Development Bank.

75. **Other Cross-cutting Areas**. The consultants need to consider the following areas:

**Table 7: Cross-cutting Areas**

| Cross-cutting Area | Consideration Requirement |
|---|---|
| Resettlement | No activity under this output needs resettlement. See link document 11. |
| Indigenous Peoples | There are no indigenous peoples present in the islands. |
| Environment | Initial Environment Examination for the project covers this entire output as well. See link document. |
| Gender | Gender considerations are taken into account in Gender Action Plan of link document. |
| HIV/AIDS and Human trafficking | The entire project's HIV/AIDS and human trafficking related impacts are mitigated by a sub-output road safety awareness. See link document. |
| Economic analysis | The economic analysis has been conducted for all individual road segments as well the entire project, as shown in link document. |
| UXO | UXO is a risk during civil works implementation which is avoided by a survey during detailed design to identify risk areas and removing the UXO prior to all civil works commence. This is a pre-requite activity included in all civil works contracts, without completion of which MRD does not allow site possession for the contractor. |

MRD = Ministry of Rural Development, UXO = unexploded ordnance.
Source: Asian Development Bank.

## F. Monitoring

76. Table 8 summarizes the specific monitoring indicators for the output, while under output (iii) of para. 4, a sub-output "sex-disaggregated socioeconomic baseline survey" will cover all 5 project outputs to establish baseline (2015) and project performance year (2019) data, which are more detailed monitoring indicators.

**Table 8: Monitoring the Connectivity Improvements for Mekong River Islands Output through Specific Indicators**

| Results | Indicators | Source of verification |
|---|---|---|
| 1. MRD mainstreams climate change risks and resilience in provincial road planning and improvements by 2019 | MRD road transport policies adjusted to incorporate climate risks, and decision making appropriately reflects vulnerability (including gender dimension) studies | MRD Annual Report; MRD website<br>Monthly Progress Reports |
| | MRD budget allocations consider climate change vulnerabilities of priority roads | MRD Annual Report; MRD website |
| | Road maintenance works in MRD roads are aligned with climate patterns | Monthly Progress Reports |
| 2. MRD changes manuals to incorporate climate resilient design of roads by 2019 | Road rehabilitation and new road construction will follow 100-year flood design | MRD Design Manual<br>Monthly Progress Reports<br>MRD Annual Report; MRD website; ADB Project Completion report |
| | Hazard maps for national and provincial roads of MRD completed and used routinely | Monthly Progress Reports |

| Results | Indicators | Source of verification |
|---|---|---|
| | in prioritizing road maintenance operations | |
| 3. MRD disseminates knowledge on climate resilience within Cambodia by 2019 | At least 20 staff from MRD participate in regional climate change adaptation forums and participate in PPCR knowledge dissemination (e.g., publications, studies, knowledge sharing platforms, learning briefs, communities of practice, etc.) | MRD Annual Report; MRD website<br>Monthly Progress Reports |
| | MRD organizes climate resilience related conferences annually in collaboration with related stakeholders like the MOE and MPWT | Annual Reports of MRD, MOE and MRD; Websites of MRD, MOE, and MRD<br>Monthly Progress Reports |
| | MRD continues to collaborate with Cambodian universities to integrate climate change in curriculum of environmental and transport engineering | Annual Reports and web sites of MRD and universities;<br>Monthly Progress Reports |
| 4. Increased capacity of Mekong River Island roads to withstand climate change impacts by 2019 | 50 km of island road enhanced to climate resilient codes and standards for ensuring all-year access | MRD Annual Report; MRD website; ADB Project Completion Report<br>Monthly Progress Reports |
| | Green planning and planting completed along at least 900 km of roads | MRD Annual Report; MRD website<br>Monthly Progress Reports |
| 5. Increased water capture facilities in Mekong River Islands by 2019 | Water capture interventions in Mekong River Islands completed | MRD Annual Report; MRD website<br>Monthly Progress Reports |
| 6. Strengthened emergency management in Mekong River Islands with extreme climate induced calamities by 2019 | Early warning systems established in Mekong River Islands | MRD Annual Report; MRD website; ADB Project Completion Report<br>Monthly Progress Reports |
| | All residents are evacuated in a timely manner during a calamity in affected areas of Mekong River Islands with emergency facilities | MRD Annual Report; MRD website; ADB Project Completion Report<br>Monthly Progress Reports |
| | All livestock is moved to safe areas during a calamity in affected areas of Mekong River Islands with no shortage of feed | MRD Annual Report; MRD website; ADB Project Completion Report<br>Monthly Progress Reports |

ADB = Asian Development Bank, km = kilometers, MOE = Ministry of Environment, MPWT = Ministry of Public Works and Transport, MRD = Ministry of Rural Development.
Source: Asian Development Bank.

## OVERALL CLIMATE CHANGE ADAPTATION POLICY AREAS ACHIEVED TO-DATE

1. There are several policy areas in climate change adaptation context that the Rural Roads Improvement Project[1] has initiated and achieved, as described below:

a. **Replication:** The approach for replication of the initiatives in the proposed Connectivity Improvements for Mekong River Islands Output stem from two policy areas: one is the poverty and gender aspects. The other is the potential application and/or replication of climate change adaptation in many other similar areas, some in other island clusters in the Mekong River, another in the Tonle Sap watershed where similar communities exist, and even in remote rural areas (though not separated from mainland by a body of water) which are totally disconnected from paved national and/or provincial road network given the extensive rural road network of nearly 40,000 km (in comparison with about 12,000 km of national and provincial road network).

b. Apart from potential replication in Cambodia as outlined above, there are other geographical locations in Mekong River in Lao Peoples Democratic Republic, or archipelagic locations of Indonesia, the Philippines and Pacific Islands that may replicate this approach, with certain adjustments, to achieve self-sustainability, poverty reduction through inclusive growth, and most of all, climate resilience.

c. The 5-island cluster has a total population of about 30,000, which is quite significant with respect to the benefits that this Output may provide, given the economic rate of return for the individual roads and jetties is above 12% threshold, with the entire output, as well as the overall proposed project passing this economic viability criteria.

d. This approach may be extended to any remote community in Cambodia that it may be replicated, with appropriate adjustments to geographical parameters, to achieve self-sustainability, poverty reduction through inclusive growth, and climate resilience.

e. **Application of Climate Change Adaptation (CCA) Output's outcomes from Loan 2670[2] in Cambodia:** This, in fact, has been happening since 2 years ago even outside the Ministry of Rural Development (MRD) when the Asian Development Bank (ADB) designed the Increased Climate Resilience Output under Provincial Roads Improvement Project,[3] which is being implemented now by the Ministry of Public Works and Transport (MPWT). The knowledge from CCA Output has been, and will be applied, with effective coordination with the CCA Output. Hazard mapping developed under the CCA Output will be directly utilized to plan maintenance activities in the Project area. Experience from emergency management pilot of the CCA Output will be used to plan emergency management in this Project's area. Green planning initiated in the CCA Output is also planned here, which will start with creating jobs for residents from a dedicated nursery to raise seedlings to tree planting over the national and provincial road sections, which MPWT is planning to continue over the entire road network under their jurisdiction, even after this project. This type of output and/or activities is expected to become a standard in newly proposed projects.

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[1] ADB. 2010. *Report and Recommendation of the President to the Board of Directors: Proposed Loan to the Kingdom of Cambodia for Rural Roads Improvement Project*. Manila (Loan 2670-CAM).

[2] Footnote 1.

[3] ADB. 2011. *Report and Recommendation of the President to the Board of Directors: Proposed Loan to the Kingdom of Cambodia for the Provincial Roads Improvement Project*. Manila (Loan 2839-CAM).

f. Climate resilience knowledge from the CCA Output has been introduced into projects those have been approved prior to Loan 2670. One example is Greater Mekong Subregion: Cambodia Northwest Provincial Roads Improvement Project.[4] The 29-km road section in National Road 56, to be improved under the project, was totally impassable during the 2011 floods, thus on the request of MPWT, ADB approved a contract variation in 2012 to redesign this road section to be climate resilient based on the basic principles of the CCA Output, works are currently ongoing.

g. Another example is the Flood Emergency Management Project[5] for three agencies MPWT, MRD and the Ministry of Water Resources, Hydrology, and Meteorology, which used the pilot approach from CCA Output in this project's design to have national level application of emergency management planning to assist the National Disaster Reduction Committee.

h. The Connectivity Improvements for Mekong River Islands Output has been totally designed based on CCA Outputs knowledge. Hazard maps were effectively used, with rainfall data and benchmarks were applied to study the infrastructure design (roads with drainage and jetties) to provide 365-day access to the islands where more than 10 lives were lost, and unaccounted losses of livestock have been reported annually. Further, emergency management planning knowledge is also applied here to save those lives and livestock.

i. Following Loan 2670, MRD has included climate resilience as one priority area in 2012 in their policy, which has already been approved by the MRD Minister.

j. **Linkage between ongoing CCA Output and Connectivity Improvements for Mekong River Islands**. As explained above, all policy areas proposed and/or implemented under the CCA Output have been moving forward in several other projects already. This is even more prominent in the Connectivity Improvements for Mekong River Islands Output, but not limited to one output, which stands out visible though.

k. Summarizing the linkage between CCA Output and the proposed project, we observe the following: in the road improvement output, all road designs in flood prone areas have adopted climate resilient road design over the proposed 1,031 km of rural roads. Rural road asset management output of the project incorporates outcomes of the CCA Output in planning road maintenance works, taking into account predicted climate patterns. In the project management support output, there is already an established SEO in the ongoing Loan 2670, which will be further strengthened during the proposed project to increase the capacity of the environment specialists through continuous engagement on the job, while increasing the resources.

l. In the Connectivity Improvements for Mekong River Islands Output, there are two major sub-outputs. Sub-output 1: Improved climate resilient access to Mekong River Islands; and Sub-output 2: Climate Change Adaptation Framework. While sub-output 1 aims to improve the year-around access to islands though climate resilient design that includes drainage and water management, sub-output 2 aims to develop a climate change adaptation framework and implement the related activities through a multi-sector approach for inclusive growth in the islands in a sustainable manner. This sub-output 2 takes the policy agenda

[4] ADB. 2009. *Report and Recommendation of the President to the Board of Directors: Proposed Loan to the Kingdom of Cambodia for the Greater Mekong Subregion: Cambodia Northwest Provincial Road Improvement Project*. Manila (Loan 2539-CAM).

[5] ADB. 2012. *Report and Recommendation of the President to the Board of Directors: Proposed Loan to the Kingdom of Cambodia for the Flood Damage Emergency Rehabilitation Project*. Manila (Loan 2852-CAM).

initiated under CCA Output further to a broader application in Cambodia as its first initiative. Therefore, the proposed project is designed to take the policy agenda of Loan 2670 forward in all perspectives of the project.

m. **Integration of CCA to the Entire Project:** From the discussion points above, we can observe how: (a) the proposed project has integrated CCA activities to the whole project; (b) the important and valuable climate change related knowledge introduced in MRD through the CCA Output has expanded in scale and scope; (c) the proposed project applies a systematic continuation of this CCA Output activities further; and (d) the expansion of CCA activities has been taking place over the transport sector in Cambodia. Therefore, important initiatives have progressed into the proposed project's climate change adaptation activities, integrated to the overall project, but not as a stand-alone activity allowing any risk of marginalization.