Concept Note for the Use of Resources from the PPCR Competitive Set-Aside (Round II)			
Country/Region:	Cambodia	**CIF Project ID#:**	To be assigned
Project/Program Title:	**Rainwater Harvesting and Drip Irrigation for High-Value Crop Production in Cambodia**		
Date of Endorsement of the Investment Plan:	Endorsement of SPCR Endorsement of revised SPCR	29 June 2011 11 February 2014	
Funding Request (in million USD equivalent):	Concessional Loans	$5 million	
Implementing MDB(s):	Asian Development Bank (ADB)	✓ Private sector arm ☐ Public sector arm	
Executing Agency:	Akay Cambodia Limited		
MDB Focal Point and Project/Program Task Team Leader (TTL):	Headquarters- Focal Points: Mrs. Cinzia Losenno Senior Climate Change Specialist PPCR Focal Point closenno@adb.org Mr. Don Purka Principal Investment Specialist CIF Private Sector Focal dpurka@adb.org	TTL: Mr. Shuji Hashizume Investment Specialist Private Sector Operations Dept shashizume@adb.org	

I. Project Description

1. This Project introduces drip irrigation[1] and improved rainwater harvesting[2] technologies to a 720 hectare demonstration farm in Battambang Province in Cambodia (the "model farm") with the aim of disseminating climate resilient farming methods to local farming communities. The model farm has been developed as a training centre for approximately 4,000 local farmers with landholdings in the surrounding region (typically 2 hectare plots), and farmers use the facility to learn about new agricultural practices and technologies for growing high-value crops (such as organic spices). Using knowledge gained from the model farm (including rainwater harvesting and drip irrigation technology), local farmers are beginning to cultivate the surrounding land, estimated at approximately 20,000 hectares. Farms in the region are typically rain-fed for 7-8 months a year, and irrigation is needed to cover the 4-5 month dry season. Using drip irrigation fed from harvested rainwater, farmers will be able to irrigate year round without having to extract water from irrigation canals, lakes, rivers or groundwater reserves. Under the proposed "outgrower scheme", the developer of the model farm, Akay Cambodia Limited ("Akay Cambodia") will act as an offtaker for local produce and will export processed products to international markets, primarily in China, the US and Japan.

2. PPCR funds will be used for (i) a loan to Akay Cambodia for capital expenditure for establishing demonstration drip irrigation and rainwater harvesting ponds on the model farm ($1 million concessional loan), and (ii) a loan to Akay Cambodia for on-lending to local farmers to pay for the capital outlay and

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[1] Drip irrigation, also known as trickle irrigation or micro irrigation or localized irrigation, is an irrigation method that saves water and fertilizer by allowing water to drip slowly to the roots of plants, either onto the soil surface or directly onto the root zone, through a network of valves, pipes, tubing, and emitters.

[2] Rainwater harvesting is the collection and storage of rainwater for reuse before it reaches groundwater systems such as aquifers. The harvested water can be used for irrigation, drinking water and other purposes.

installation costs for rainwater harvesting ponds and drip irrigation systems for individual farms, and also potentially for additional agricultural inputs such as high quality seeds, plants, fertilizers and pesticides ($4 million concessional loan to Akay Cambodia, to be administered by Akay Cambodia and/or a local financial intermediary). Akay Cambodia will support these investments with technical assistance administered through the model farm in line with its normal operations as a learning and resource facility. The project will be implemented in parallel with a commercial loan from ADB's Private Sector Operations Department to Akay Cambodia of $4.5 million for: (i) purchasing additional agricultural equipment for the model farm ($1.5 million loan), and (ii) building a spice processing plant in Phnom Penh to handle the increased volume of raw produce ($3 million loan)[3]. The Agence Française de Développement (AFD) is also considering financing support to Akay Cambodia's outgrower scheme[4].

3. The project is currently at an advanced stage of readiness. The project developer is suitably positioned to deploy the additional capital resources, and has been planning an expansion of their Cambodian operations for the last 12 months. Following PPCR Sub-Committee's approval, ADB expects to approach its board for approval for PPCR and ADB resources in Q3 2014, and would likely start deploying funds by the end of 2014. The model farm has already piloted the use of rainwater harvesting ponds with a high degree of success, and is looking to expand this element of the project along with the introduction of drip irrigation systems.

Objectives and expected outcomes

4. The project aims to kick-start the adoption of rainwater harvesting and drip irrigation technologies in Cambodia coupled with high-value crop production such that farming can be conducted year-round without having to extract river, lake or groundwater resources. Agriculture in Cambodia is dominated by rice farming, and there is a strong need to diversify the sector, particularly towards growing higher value crops. More broadly, the project aims to introduce a financially sustainable, road-tested private sector agri-business model that promotes export-oriented, high revenue-generating agricultural activity built on the principles of climate resilience, environmental sustainability and pursuing mutual benefits between local communities and agribusiness developers. The project aims to boost the climate resilience of Cambodia's agricultural sector (the Tonle Sap Lake Floodplain in particular), and leapfrog traditional inefficient furrow irrigation and hand-watering techniques.

5. By providing capital for both model systems and on-lending, the project aims to demonstrate that farming revenues can be increased through improved water management practices and technologies. These will deliver better crop yields at lower cost, whilst protecting against future potential impacts of climate change (mainly drought induced crop failures). The model farm provides an effective real-world tool for farmers to learn about new technologies, new varieties of crops and organic farming methods. It is expected that by demonstrating the success of the business model (and de-risking it in the context of Cambodia), farmers, financiers, and agribusiness developers in other parts of the country will likely replicate the model.

6. The broader objectives of the project are:

- To alleviate crop failures caused by rainfall shortages;
- To enhance food security and support efforts to reduce poverty;

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[3] This is part of a larger intervention by ADB's Private Sector Operations Department that will also provide a $10 million loan to Akay Flavours & Aromatics Pvt. Ltd. for expansion of Akay Group's processing facilities in India. The ADB team received concept clearance for a non-sovereign assistance to the Akay Group in January 2014. In March 2014, the ADB team conducted a commercial, technical, environmental, and social due diligence in India (Cochin) and Cambodia (Battambang farm and Phnom Penh). The ADB Board approval for the proposed non-sovereign assistance in India and Cambodia is scheduled on July 2014.

[4] AFD support is under processing and would be complementary to ADB's proposal

- To improve agricultural practices, crop yields and productivity in Cambodia by demonstrating the use of efficient and climate-proofed water resource management technologies (drip irrigation and rainwater harvesting);
- To build the climate resilience of Cambodia's agricultural private sector, protecting businesses and livelihoods from the negative effects of climate variability and change;
- To promote crop diversification and the use of high value, drought resistant crops to stimulate economic development and improve the income and livelihood of rural communities;
- To support initiatives to lessen the environmental impact of farming;
- To promote south – south cooperation on climate resilience projects and business ideas including the transfer of capital, knowledge, capacity building, and market infrastructure; and
- To raise awareness among private actors in the agricultural sector of the importance of investing in products/services that enhance the climate resilience of their operations.

II. Context and market

Country context

7. Cambodia is one of the most disaster-prone countries in Southeast Asia and is affected by floods and droughts on a seasonal basis. It is ranked 8th highest on the World Risk Index for vulnerability to the impacts of climate change[5]. This vulnerability is linked to Cambodia's characteristics as a post-civil war, least developed, predominantly agrarian state. Agriculture directly contributes to 32% of gross domestic product and employs 60% of the workforce, while 80% of the population depends on the sector for their livelihood. Weak adaptive capacity, poor infrastructure and limited institutions exacerbate the country's vulnerability to climate variability and change, and there is a strong need to build resilience in the agricultural sector due to its critical role in supporting the country. Despite this situation, climate change problems in Cambodia are predominantly addressed through post-disaster relief operations after extreme weather events and there appears to be a lack of longer term planning and building of climate resilience[6].

8. The economic value of Cambodia's main agricultural region, the Tonle Sap Lake Floodplain, is arguably among the highest provided to a nation by a single ecosystem around the world. The Mekong river drains 86% of Cambodia and provides 60% of the water for the Tonle Sap plains. However, the Mekong River Basin is changing rapidly due to accelerating water infrastructure development (hydropower, irrigation, flood control, and water supply) and climate change, bringing considerable modifications to the flood pulse of the Tonle Sap Lake and the local hydrological balance. Changes in climate are also expected to increase the variability of rainfall in Cambodia, thus making irrigation even more important to agricultural production (monsoon rain accounts for between 80-90 percent of the country's annual precipitation). Agriculture in Cambodia is dominated by smallholder rice farming, which absorbs 90% of total cultivated land, albeit often with very low yields and for subsistence farming only[7]. Thus there is a strong need to diversify Cambodian agriculture, especially towards high-value cash crops such as spices.

9. Notwithstanding these challenges, Cambodia has strong potential to become a large-scale producer of high value crops including spices due to its fertile soils and tropical monsoon climate. Farmers are experienced in basic small-scale farming practices, but lack access to productivity enhancing inputs such as seeds, water, technology, information and training. Furthermore, few have access to guaranteed and profitable markets for their output. The majority of local farmers in the project's province

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[5] http://www.worldriskreport.com/

[6] United Nations Development Program, 2011. Promoting Climate Resilient Water Management and Agricultural Practices in Rural Cambodia, December 2011.

[7] ADB. 2011. Country Partnership Strategy: Cambodia (2011–2013). Manila.

are ex-soldiers who were allocated 2 hectares of land each by the government in an effort to turn "guns into ploughshares." Farmers are typically poor, uneducated and depend only on rice, corn or cassava cultivation, which provides low levels of income and leaves farmers vulnerable to price volatility due to the low diversification of crops.

Market context

10. Farms in Cambodia are typically rain fed for 7-8 months each year and experience rainwater shortages for 4-5 months during the dry season from January to April. The majority of rice production in Cambodia is based on rain fed lowland cropping systems, where rice is grown over the wet season, and fields are left to fallow over the dry season[8]. Traditional irrigation techniques depend primarily on low efficiency methods of furrow/surface irrigation[9] and hand watering.

11. The existing irrigation infrastructure and practice in Cambodia is largely a legacy of the Khmer Rouge. During their rule in the late 1970s, a network of canals, ditches and dykes for furrow irrigation was built across the country with little regard to hydrology. The lack of topographic survey and poor construction standards of canals often meant that controlling flows was difficult and higher areas were often drained of water, leaving them prone to drought and crop failure. The canal network required constant attention for operation and maintenance. Now in 2014, irrigation practices have improved in some areas, and the canal network has become more functional. However, evaporative losses from this system are still high, which leads to low irrigation water efficiencies. Modern irrigation technologies, such as drip irrigation, offer significant benefits to farmers; on-farm trials in Cambodia for vegetable growing show that drip irrigation can result in 95% and 85% increases in water and labor productivity respectively[10]. Drip irrigation technology is well-proven and widely commercially available in developed and many developing countries/regions, for example in the People's Republic of China[11], Central Asia[12], South Asia[13], and Sub-Saharan Africa[14].

12. Rainwater collection in Cambodia for purposes other than irrigation (mainly drinking water and sanitation) has been practiced by rural communities for many years as a way to survive the dry summer months[15,16]. Most people collect water from their roofs. However, rainwater collection at scale for irrigation purposes is not yet a concept that has been adopted by farmers. In 2006, the Cambodian government developed a National Adaptation Program of Action (NAPA) for Climate Change in 2006,

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[8] Seng, V., Eastick, R., Fukai, S., Ouk, M., Men, S., Chan, S., Nget, S., 2008. Crop diversification in lowland rice cropping systems in Cambodia: effect of soil type on legume production. "Global Issues. Paddock Action." Edited by M. Unkovich. Proceedings of 14th Agronomy Conference 2008, 21-25 September 2008, Adelaide, South Australia.

[9] Surface irrigation is defined as the group of application techniques where water is applied and distributed over the soil surface by gravity. It is by far the most common form of irrigation throughout the world and has been practiced in many areas virtually unchanged for thousands of years.

[10] Palada, M, Bhattarai, S, Roberts, M, Baxter, N, Bhattarai, M, Kimsan, R, Kan, S & Wu, D 2010, 'Increasing on-farm water productivity through farmer-participatory evaluation of affordable microirrigation vegetable-based technology in Cambodia', Journal of Applied Irrigation Science, vol. 49, no. 2, pp. 133-143.

[11] Ruoshui Wang, Shuqin Wan, Yaohu Kang, Chaoyin Dou, Assessment of secondary soil salinity prevention and economic benefit under different drip line placement and irrigation regime in northwest China, Agricultural Water Management, Volume 131, 1 January 2014, Pages 41-49, ISSN 0378-3774, http://dx.doi.org/10.1016/j.agwat.2013.09.011.

[12] L.S. Pereira, P. Paredes, E.D. Cholpankulov, O.P. Inchenkova, P.R. Teodoro, M.G. Horst, Irrigation scheduling strategies for cotton to cope with water scarcity in the Fergana Valley, Central Asia, Agricultural Water Management, Volume 96, Issue 5, May 2009, Pages 723-735, ISSN 0378-3774, http://dx.doi.org/10.1016/j.agwat.2008.10.013.

[13] Dennis Wichelns, Investing in small, private irrigation to increase production and enhance livelihoods, Agricultural Water Management, Volume 131, 1 January 2014, Pages 163-166, ISSN 0378-3774, http://dx.doi.org/10.1016/j.agwat.2013.09.003.

[14] Louise Karlberg, Frits W.T. Penning de Vries, Exploring potentials and constraints of low-cost drip irrigation with saline water in sub-Saharan Africa, Physics and Chemistry of the Earth, Parts A/B/C, Volume 29, Issues 15–18, 2004, Pages 1035-1042, ISSN 1474-7065, http://dx.doi.org/10.1016/j.pce.2004.08.004.

[15] http://www.cee.ntu.edu.sg/Temp/LIFE/cambodia_projects.html

[16] http://www.rainwatercambodia.org/index.html

which incorporated elements of improved rainwater harvesting facilities at the community level. However, currently very few farmers harvest rainwater to irrigate their crops.

Company Background

13. Akay Cambodia is a Cambodian company, founded in 2009 with majority Cambodian ownership. It was established to develop the model farm and outgrower business model in Battambang, and is associated with the India-based company Akay Flavours & Aromatics Pvt. Ltd., ("Akay India") through ownership from a common set of investors. Akay Cambodia and Akay India are distinct, separate entities. However, in practice, Akay India supports Akay Cambodia with technical and managerial inputs from its twenty year track record of developing agribusiness projects. Akay India has been successful demonstration a model farm with outgrowers in Karnataka India, where it currently engages farmers through contract farming of chili peppers. It has also implemented drip irrigation systems for its India operations, and has approximately 1,300 hectares of land equipped with drip irrigation infrastructure to grow chili peppers and turmeric. Since its establishment in 1993, Akay India has grown to one of the top five exporters of spice oleoresins in the world. It is headquartered in Cochin, Kerala and operates five processing plants (four in India and one in the PRC) with a total capacity of 32,000 tons per year. Akay distinguishes itself from its peers in putting core value in social development, job creation, gender empowerment, and sustainability as it deals with a large number of poor farmers. Akay India estimates it has impacted over 60,000 farmers and their families to date.

III. Project description and Innovation

a. Project Description

14. The project has been designed with two components: (i) demonstration of rainwater harvesting ponds and drip irrigation networks for the model farm, and (ii) a line of credit to local farmers to enable them to construct rainwater harvesting ponds and to purchase drip irrigation hardware for their own farms and/or additional agricultural inputs such as high quality seeds, plants, fertilizers and pesticides.

15. For component (i), PPCR funds of $1 million would be lent to Akay Cambodia for costs relating to the construction of rainwater harvesting ponds, and the purchase and installation of drip irrigation hardware. To date, the model farm has piloted 34 rainwater harvesting ponds with a combined capacity of 43,000 m^3. Under the project, these will be expanded to give an increased capacity of 121,000 m^3, and an additional 37 new rainwater harvesting ponds will be built. In total, this will provide approximately 231,000 m^3 of rainwater harvesting capacity for the 720 hectare model farm, which will make it self-sufficient in terms of water requirements. Information on the ponds and a map is provided in Appendix 2. The model farm has piloted sprinkler irrigation on 23 hectares of land, and is currently engaging with drip irrigation technology providers from India and the Middle East regarding the introduction of drip irrigation to the model farm. Drip irrigation has not yet been piloted on the model farm; however lessons from other countries indicate that drip irrigation has strong potential in the Cambodian context. Estimates for the cost of construction of ponds and installation of drip irrigation hardware combined vary between $1,700 and $2,500 per hectare, depending on the type of crops to be grown. With potential funding of $1 million, Akay Cambodia has put together a financial plan based on rainwater harvesting ponds and drip irrigation for a total of 536 hectares of black pepper, turmeric, cocoa, dragon fruit and rubber (please refer to section 3 of this concept paper).

16. For component (ii), PPCR funds of $4 million would be lent to Akay Cambodia to be used to extend a line of credit to local farmers participating in the outgrower scheme to construct ponds and to purchase and install drip irrigation hardware. Funds may also be used for other agricultural inputs such as

high quality seeds, plants, fertilizers and pesticides. Technical assistance for the construction, installation, operation and maintenance of ponds and drip irrigation networks, and for other agricultural inputs will be provided to farmers by Akay Cambodia through the learning and demonstration facilities developed at the model farm. Funds would be administered by Akay Cambodia and/or by a suitable local financial intermediary (local commercial bank or micro-finance institution), who would assess the creditworthiness of individual farmers, manage individual loan agreements, and handle payments. ADB is holding discussions with several financial intermediaries (several of whom are existing ADB clients) to confirm their interest in participating in the project. Akay Cambodia will be the obligor(s) for the $4 million PPCR loan, and will assume the responsibility for repayment. The loans to outgrowers would be governed by separate loan agreements for each farmer.

17. There is also a non-PPCR component of ADB's planned non-sovereign assistance to Akay Cambodia. As mentioned in section I of this paper, commercial funding of $3 million from ADB's Private Sector Operations Department (PSOD) along with $1 million in equity from Akay Cambodia would be used for the construction of a spice processing plant to be built in Phnom Penh. This will allow Akay Cambodia to process greater volumes of raw produce from the model farm and outgrowers. PSOD is also processing a $10 million commercial loan to support Akay India's processing facilities in India.

b. Level of Innovation

18. The project uses innovative technologies and also pioneers an innovative new private sector business model for Cambodia. Rainwater harvesting for irrigation is cheap, avoids extraction of environmental flows and allows farmers to irrigate and grow crops year round. Drip irrigation technology fed through rainwater harvesting ponds offers significant economic and environmental advantages over traditional irrigation techniques[17]. Not only does it avoid dependency on large scale irrigation canals, but on-farm trials in Cambodia for vegetable growing show that drip irrigation can result in increases in water efficiency (95%) and increases in labor productivity (85%)[18]. Trials show that economic returns to labor can increase by 67%, and the integration of improved crop management methods such as combining fertilizer with drip irrigation, can increase both yields and water use efficiency. Overall, average labor use decreased 83% with drip irrigation, increased net returns by 153% and provided water savings of 48% compared with traditional practice.

19. The "outgrower" business model is innovative as it is both financially compelling, and able to provide a range of benefits to local farmers and their communities, project developer's and the local environment. Local farmers benefit primarily through increased income-generating potential from growing high-value crops rather than rice, corn and cassava. It also increases their income security, firstly from increased climate resilience and less risk of crop failure from drought, and secondly by being able to secure favorable returns on their investments by having direct access to appropriate capacity building, technology and viable markets (local, regional, global) for their end product. The project offers significant gender related benefits by promoting the role of women in the workforce - currently around 70% of workers on the model farm are women, and their knowledge and learning is promulgating through the local communities. From the project developer's perspective, the business model provides benefits of being able to scale up operations in fertile agricultural regions without having to acquire large portions of land. The developer is also able to focus their efforts on developing a larger share of international markets for the benefit of both the company and the local farmers involved in the outgrower scheme. The

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[17] Palada, M.C., Bhattarai, S.P., Roberts, M.S., Bhattarai, M., Baxter, N., Kimsan, R. and Wu, D.L. 2011. Improving Smallholder Dry Season Vegetable Production Through Increased Water Productivity With Low Cost Drip Irrigation Technology in Cambodia. Acta Hort. (International Society for Horticultural Science) 922:133-140.

[18] Palada, M, Bhattarai, S, Roberts, M, Baxter, N, Bhattarai, M, Kimsan, R, Kan, S & Wu, D 2010, 'Increasing on-farm water productivity through farmer-participatory evaluation of affordable microirrigation vegetable-based technology in Cambodia', Journal of Applied Irrigation Science, vol. 49, no. 2, pp. 133-143.

environment benefits from the adoption of improved agricultural practices and alleviation of pressure on ecosystems, particularly during droughts, from reduced river, lake and groundwater extraction.

20. Through demonstrating drip irrigation and rainwater harvesting, the business model has strong potential to make tangible improvements to the agricultural sector in Cambodia. It introduces powerful new potential through its education and outreach elements – features that are new to agribusiness projects in Cambodia[19]. Using this business model, developers can influence agricultural practices across large areas and multiply production figures for efficiently produced, low environmental impact, climate-resilient, high-value agri-products. By providing financing to this project, PPCR would be helping to de-risk and to "mainstream" a business model that provides significant benefits to local communities, agri-business developers and the environment.

c. Technology, Product, and/or Business Model

21. Drip irrigation, also known as trickle irrigation, involves dripping water onto the soil at very low rates (2-20 litres/hour) from a system of small diameter plastic pipes fitted with outlets called emitters or drippers. Water is applied close to the plant's base to irrigate only the part of the soil in which roots grow, unlike surface and sprinkler irrigation, which involves wetting the whole soil profile. With drip irrigation, water applications are more frequent (usually every 1-3 days) compared with other methods and this provides a more consistent level of moisture in the soil.

22. Properly designed, installed and operated, drip irrigation improves water conservation by reducing evaporation and deep drainage compared to flood irrigation methods or overhead sprinklers. Using drip irrigation, water can be more precisely applied to plants' roots. In addition, drip irrigation can eliminate many diseases that are spread through water contact with the foliage. The advantages of drip irrigation include:

- High water application efficiency (evaporative loses are minimized)
- Distribution is controllable through valves and drippers
- Nutrient and fertilizer loss is minimized due to localized application and reduced leaching
- Soil erosion is minimized
- Weed growth is minimized
- Foliage remains dry, reducing the risk of disease
- Moisture within the root zone can be maintained at field capacity
- Field leveling is not necessary
- Fields with irregular shapes are easily accommodated
- Recycled non-potable water can be safely used
- Labor cost is less than other irrigation methods
- Reduced energy costs from lower operating pressure compared with other types of pressurized irrigation

23. Rainwater harvesting for agricultural purposes involves the use of any structure built to capture rain - ponds, tanks, or reservoirs. In this case it involves digging ponds in low-lying areas next to fields where water can collect (through engineered or natural drainage). Correctly designed and sized systems provide farmers with sufficient water to irrigate throughout the year. By conserving the monsoon rain that falls during the wet season, farmers can increase the area they irrigate, grow crops in the dry season, support livestock and even recharge groundwater. Stored rainwater can also provide families with water for household needs.

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[19] As part of its outreach efforts, the Akay Model Farm has also established an in-field training program with the Department of Agriculture at the local university, Battambang University. The program requires agriculture students in graduate programs to work on the model farm as trainees for minimum three months as part of their curriculum

24. The advantages of rainwater harvesting include:

- Increased production – crops can be grown year round
- Increased reliability and reduced risk of crop failure from water shortages
- An economical alternative to groundwater and river water extraction
- Reduced environmental pressure from water extraction from rivers during critical summer months, ensuring adequate water remains to support native ecosystems
- High water quality - rainwater is low in minerals and suitable for irrigating sensitive plants
- Rainwater is not regulated by water restrictions

d. Sustainability of intended results

25. The project is sustainable in several ways. In terms of ground-level operations, the developer has established a business model based on engaging with local communities and building strong links to pursue shared, long-term goals of increased economic growth, inclusive social benefits, and environmental sustainability. It is a good example of south-south cooperation and involves the exchange of resources, technology, and knowledge between Cambodia and India. Akay has already established a successful outgrower model in India, where they source chili peppers from over 1,400 farmers, and will bring this experience to Cambodia. They have also introduced drip irrigation to 1,300 hectares of land used to grow chili and turmeric in India. From 2009, Akay Cambodia has worked closely with the village communities who now support the model form as a driving force for developing the local farming district. The development of a model farm and the provision of training have yielded mutual benefits for both local farmers and Akay Cambodia, and this initiative has built strong support from the local farming communities This has manifested itself also in the fact that village elders are encouraging young farmers to work with Akay Cambodia in order to learn farming techniques.

26. The project is financially sustainable, mainly due to the short payback period for drip irrigation and rainwater harvesting systems. The capital outlay is estimated at approximately USD 2,000 per hectare (for ponds and drip irrigation combined), and for outgrowers under likely assumptions and scenarios, the payback period is around 3 years. Once local financial institutions and microfinance institutions such as ACLEDA Bank or PRASAC are able to see a successful track record of deployment of such systems stemming from this program, they are likely to become more comfortable with the risks involved in such transactions, and additional financing for replication and scale up is likely to be more readily available.

27. The project is sustainable in terms of the current enabling environment in Cambodia. The project aligns strongly with the objectives of Cambodia's endorsed Strategic Program for Climate Resilience and focuses on two of its main aims for promoting climate-resilient agriculture. These are: (i) improving rainwater harvesting systems and enhancing resilience of community water supply, and (ii) enhancing the resilience of small scale agriculture through introduction of drought/flood tolerant crop varieties and small scale irrigation. Further to this, Cambodia is geographically close to China, India and other large produce and spice importing markets, and being part of ASEAN it is a tax free environment for export oriented agri-business products. Cambodia has limited restrictions on the import and export of foreign currencies, which offers benefits for export oriented trade, and can facilitate greater south-south cooperation.

28. The model farm initiative has been critical in developing the government's understanding and appreciation of the value of developing high value crops for local and international markets. In support of Akay Cambodia's initiative, the government recently started developing a new road from Samlot district in Battambang Province to the new Cambodian sea port being built in Kok Kong, at the Gulf of Thailand. This new road touches the boundary of the model farm. It is believed that once this trade route road is

developed fully in 2-3 years, it will significantly boost the agricultural exports from this area. Local farmers have already seen the value of their land appreciate as a result of increased access to transportation routes and interest in the new farming methods.

29. The model farm has received strong support from Akay India, both in terms of advisory and material support. The Akay Group now operates six processing plants with a total capacity of 32,000 MT and is currently attempting to raise funds to increase this to eight processing plants with a total capacity of 45,000 MT (6 plants in India, 1 in China and 1 in Cambodia). The company is planning to establish a processing and extraction plant in Cambodia for further value addition of spices (mainly grinding and steam sterilization of spices, oleoresins, natural food colors and essential oils). The new plant will increase the sustainability of the project as Akay Cambodia will have a strengthened supply chain in terms of processing, and farmers will have better certainty regarding the long-term offtake of their produce.

IV. Inclusivity

30. Battambang Province has an estimated population of 980,000[20], spread among 13 districts, 95 communes and 741 villages. The province has an average population density of 84 people/km^2 (national average is 75 people/km^2) and an average household size of 5.2 people. The province's mainly rural population suffers from high levels poverty, low levels of wealth, low levels of income generation, and high unemployment. Consumption poverty[21] in Battambang is high, and as shown in Table 2 of Appendix 3, in 2004, 27% of households were below the consumption poverty line and 32% fell into the poorest two national quintiles of national consumption. These households will struggle to have enough cash available to buy food needs on the market and to meet other expenditure needs such as health services.

31. The population in Battambang also suffers from a lack of physical assets with which they can generate household income (Table 3 in Appendix 3). Table 4 of Appendix 3 shows that most of the Province's population work in the agricultural sector (55%), have low levels of literacy 74% (68% for females), and have trouble in securing reliable income (only 34% of the labour force is active). One fifth of households in the province own no land, roughly three quarters own no animals, and fewer than one in five households own a motorbike. Households without land are dependent upon wage labor to generate cash income to buy food and other basic needs. However wage labor mostly comes from the informal sector, is unregulated, casual and often poorly paid (a typical example is agricultural casual wage labor).

32. The project would provide assistance to two main groups in the province: firstly farmers with landholdings, and secondly the workforces employed on the farms. Farmers in the region are mostly ex-soldiers who were allocated 2 hectares of land each by the Government of Cambodia. These farmers are typically poor, have little formal education, and depend on rice, corn or cassava cultivation, which provides low income and leaves farmers vulnerable to price volatility. The project would directly benefit this group through improved income earning potential, better income security and increased livelihood protection. The province's workforce on farms would benefit from a higher number of jobs (due to the higher labor inputs from spices and high value crops as compared with rice, corn and cassava), and higher income reliability (from producing diversified and higher value crops). It is anticipated that over time as the agricultural sector is strengthened, modernized and expanded through projects such as this, greater benefits will flow to rural communities, and basic indicators such as household incomes and levels of

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[20] World Food Program Provincial Food Security Profile pages for Battambang, Accessed April 2014. http://www.foodsecurityatlas.org/khm/country/provincial-Profile/Battambang .

[21] Consumption poverty refers to having insufficient cash income (or its equivalent in kind) to meet basic livelihood needs. This includes having insufficient cash income to buy foods that people need for an adequate diet as well as cash income to buy other basic needs such as shelter, clothing, health and education. This lack of market purchasing power can be an important cause of food shortages and protein-energy and micro-nutrient malnutrition in the province population.

wealth will increase.

33. In Cambodia, there is traditionally a high degree of participation by women in the agricultural sector and women make up 65% of farmers, directly contributing to the country's food security and the national agricultural output[22]. In line with national trends, the developers of the model farm have given priority to the employment of women, and at present about 70% of the workforce are women. The model farm runs childcare facilities on site, where mothers can leave their children during the day when they are working, which has enhanced women's capacity for involvement in income generating activities.

V. Financial Plan (Indicative)

34. Funds from PPCR would be used in conjunction with commercial loans from ADB's Private Sector Operations Department, equity from Akay Cambodia, and potentially additional concessional financing from Agence Française de Développement. PPCR's share thus represents less than 23% of the overall investment plan. The following table shows a breakdown of the different components of the planned investment. In Cambodia, there will be approximately 78% of debt financing, with the balance 22% as equity.[23]

Table 1 - Sources and uses of funds

Uses of Funds				**Sources of Funds**		
Item		$ million		$ million		Party
1	Cambodia model farm equipment (including rainwater harvesting ponds and drip irrigation)	2.7	16%	1	6%	PPCR
				1.7	10%	ADB
2	Cambodia credit line	4	23%	4	23%	PPCR
3	Cambodia processing plant	4.7	27%	2.2	13%	ADB
				2.5	14%	Akay Cambodia
4	India processing plants	6	34%	5	29%	ADB
				1	6%	Akay India
TOTAL		**17.4**		**17.4**		

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[22] United Nations Development Program, 2011. Promoting Climate Resilient Water Management and Agricultural Practices in Rural Cambodia, December 2011.

[23] Aside from the additional equity contribution mentioned here, Akay has contributed over $3 million to date to acquire and develop the 720 ha farmland. Inclusive of these, the debt to equity ratio in Cambodia would have been 62% debt vs 38% equity.

VI. Expected Results and Indicators

Key indicators from the Revised PPCR Results Framework[24]	Corresponding Project Indicator(s)	Expected Result(s)
1. Number of people supported by the PPCR to cope with effects of climate change; 3. Extent to which vulnerable households, communities businesses and public sector services use improved PPCR supported tools, instruments, strategies, activities to respond to CV&CC; 5. Quality of and extent to which climate responsive instruments/ investment models are developed and tested.	Uptake of water harvesting ponds: - number/capacity of ponds expanded on model farm - number/capacity of new ponds built on model farm - number of farmers implementing on outgrowers' farms - number/capacity of new ponds built on outgrowers' farms	 30 ponds / 100,000 m3 35 ponds / 100,000 m3 1,000 farmers 1,000 m3/ farm
	Uptake of drip irrigation - number of drip irrigation schemes supported by the credit line in Cambodia - number of farmers implementing on outgrowers' farms - area/length installed on the model farm - area/length installed on outgrowers' farms	 1-2 1,000 farmers 500 Ha 2,000 Ha
	Percentage of women in the workforce - on the model farm - on outgrowers' farms	 65% 65%
2. Degree of integration of climate change in national, including sector planning;	Private sectors delivers financial products that support national climate resilience objectives	Number of loans provided (TBD) % of loans provided to women (TBD)
4. Evidence of strengthened government capacity and coordination mechanism to mainstream climate resilience;	Progress towards policy that promote private sector investments in climate resilient technologies	TBD

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[24] https://www.climateinvestmentfunds.org/cif/sites/climateinvestmentfunds.org/files/Revised_PPCR_Results_Framework.pdf

VII. Implementation Arrangements and Feasibility

35. The project is currently at an advanced stage of readiness. The project developer is positioned such that they are currently able to deploy the additional capital resources, and following PPCR Sub-Committee approval, PPCR resources would be deployed alongside a commercial loan from ADB's Private Sector Operations Department (PSOD) in late 2014. MDB approval for the investment (PSOD and PPCR resources) is expected in Q3 2014.

VIII. Potential Risks and Mitigation Measures

36. **Credit risk of local farmers.** Local farmers do not have significant financial resources or assets, which presents a credit risk to the project. However, rainwater harvesting and drip irrigation systems are cost effective for an average farm, with a payback period of approximately 3 years. Land holdings are likely to be used as collateral for loans, and agricultural output from the "climate-proofed" farms (along with Akay Cambodia as an offtaker) is expected to generate sufficient income for farmers to make repayments. The credit risk of outgrowers would be examined more carefully on an individual basis by Akay Cambodia/the financial intermediary engaged to manage the line of credit.

37. **Technology risk and O&M.** Rainwater harvesting ponds are technologically simple, and pilots on the model farm have shown that local soil properties and hydrology lend themselves well to retaining water in standing ponds. Drip irrigation technology is mature and commercially available in many developed and developing countries, and is not anticipated to present significant obstacles in Cambodia. However, small irrigation networks need to be properly installed and suitably maintained to ensure even distribution of water, and the prevention of blockages. To prevent potential problems, Akay Cambodia will engage the technology supplier to adequately train local staff in correct procedures for installation, operation and maintenance. Through facilities at on the model farm, Akay Cambodia will ensure outgrowers are correctly trained to be able to install systems on surrounding farms.

38. **Soft systems (information, marketing, education and capacity building)**. In addition to the model farm, Akay Cambodia's outreach program to outgrowers will be essential for the successful implementation of the project. Many of the local farmers lack basic education, and literacy rates are not high. Therefore soft systems will need to be tailored such that farmers are sufficiently informed and equipped to install and maintain ponds and drip irrigation systems on their individual farms. Akay Cambodia will have a strong incentive to make sure soft systems are effective as not only are they dependent on the eventual produce from farms, but they are also taking on risk for repayment of the $4 million PPCR loan for onlending to outgrowers.

39. **Policy and regulatory**. Due to the value of the agricultural sector to Cambodia, the regulatory environment is relatively conducive to growth and the addition of new private sector agri-businesses. As part of ASEAN Cambodia is a tax free environment for export oriented agri business products, and Cambodia also has limited restrictions on the import and export of foreign currencies, which offers benefits for export oriented trade. However, the country has experienced political instability in recent years, and this may affect the future regulatory environment.

Appendix 1 – Further information on the model farm

41. Akay Cambodia Ltd commenced operations in 2009 after the developers bought 630 hectares of land from local owners in Prey Thom village. During 2009 to 2011, the main activities conducted on the farm were de-mining, land clearing and preparation for planting. Nurseries and some trail plots were also established. As the area had been heavily mined during the Khmer Rouge period, the company sought the services of a UN-backed mine detection team at Battambang and cleared the entire farm area of unexploded ordinances.

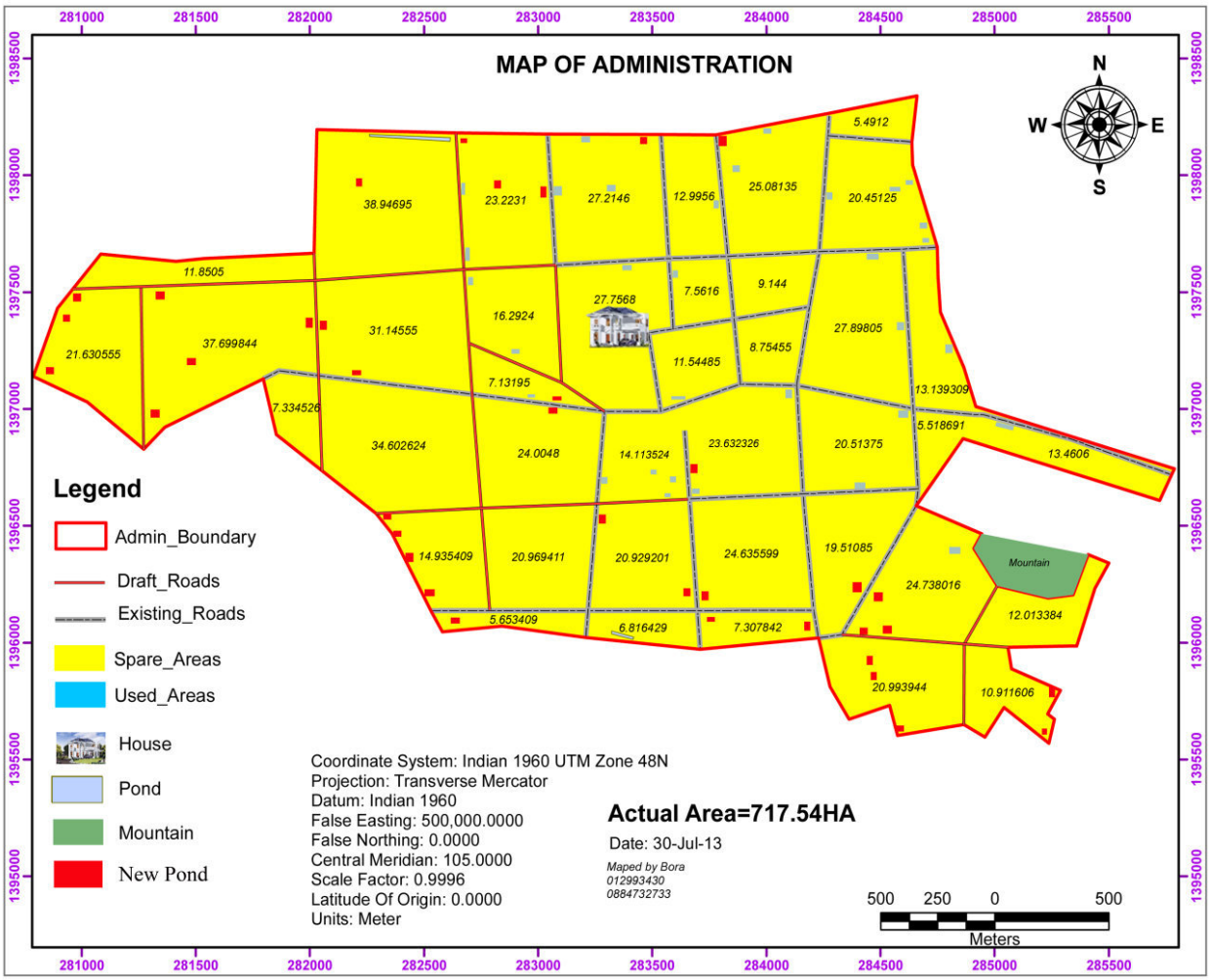
42. The strategy adopted for the model farm is a mixed crop pattern to build resilience to fluctuations in prices and production levels from varying climatic (and other) conditions. A minimum of five different crops are cultivated on the farm at a time[25]. Agricultural techniques such as crop rotation, tillage, cover crops, and the use of natural fertilizers and pesticides are being employed to improve yields and minimize the environmental impacts of farming. The Spices cultivated include short-term and inter-crops (which take 8-10 months to provide yield) and long term spices (which take 3-5 years to provide yield). Rubber (considered a long term cash crop) has been planted around the farm along with teak trees as a wind-break and also to protect the certified organic production areas from outside contamination.

43. Through its long term cultivation plan, Akay Cambodia plans to maximize the environmental sustainability of its operations. The model farm is planning to plant 1 million trees in the next 5 years and has already completed the planting of 100,000 new trees as part of its land rehabilitation program. The plan is to promote tree planting to the surrounding farms by supplying saplings of various trees to farmers.

1.

[25] The current cropping pattern is 100 hectares of an Indocert certified spice farm, 100 hectares of Cocoa intercropped with fruit trees (Litchi, Dragon fruit, Mangostene, Mangoes and Coconut), 500 hectares of Rubber intercropped with rotating crops such Turmeric, Ginger (spices), Coleus Forskolin and Kiryat (herbs). In addition a nursery for seed and saplings development, livestock management, training center for farmers, warehouses and staff accommodation has been set up on 20 hectares.

Appendix 2 - Map of existing ponds (for expansion) and planned new ponds



Appendix 3 – Demographics of Battambang Province, Cambodia

Table 2 - Indicators of Consumption Poverty in Battambang 2004[26]

Consumption Poverty indicator	Battambang	National average
Household daily per capita consumption in riel (and 2004 USD equiv.)	3,375 (USD 0.88)	3,247 (USD 0.84)
% of households in the lowest Q1 and Q2 (i.e. 40%) of national consumption quintiles	32%	37%
Consumption poverty line in riel (and 2004 USD equiv.)	1,800 (USD 0.47)	1,836 (USD 0.48)
% of households below the poverty line	27%	32%
The poverty line value as a percentage of total consumption	53%	49%

Table 3 - Indicators of Household Asset Poverty in Battambang 2004[27]

Asset poverty indicator	Battambang Province	National average
% rural households with no crop land-landless 0 ha.	20%	15%
Average crop land area cultivated for all annual crops ha./rural hh	2.1	1.2
% households with thatched roof houses	38%	34%
% HH not owning any cattle or buffalo	64%	49%
% HH not owning any pigs-CDB 2004	78%	54%
Mean no. of households per car	15	39
Mean no. of households per morto	5.3	5.4
Mean no. of households per oxcart	5.3	4.0

1.

[26] CSES 2004 Knowles Analysis. http://www.foodsecurityatlas.org/khm/country/provincial-Profile/Battambang

[27] MAFF 2004 & CDB 2004 aggregates from village data. http://www.foodsecurityatlas.org/khm/country/provincial-Profile/Battambang

Table 4 - Employment and Labor Force Indicators in Battambang 2004[28]

Employment and labor force indicator	Battambang Province	National Average
Literacy Rate > 15 years % total population	74	67
Literacy Rate > 15 years % females	68	60
% of the labor force in the primary sector incl. Agriculture	55	60
% of the labor force in the secondary sector/ Industry	8	13
% of the labor force in the tertiary sector/ Services	37	25
% of the labor force economically active >=10 days/ mth	34	29

1.

[28] CSES 2004 Kanol Analysis (NIS). 1. http://www.foodsecurityatlas.org/khm/country/provincial-Profile/Battambang