ASSESSING CAPACITY DEVELOPMENT NEED FOR SUSTAINABLE IRRIGATION DEVELOPMENT IN CAMBODIA

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ABSTRACT

Cambodia’s economic performance in recent years has been impressive, evidenced by high economic growth rates compared to global averages. However, significant challenges remain, including among other, low levels of technology adoption and the human capital to utilise such technology to improve productivity and lack of information. Cambodia has invested and plan to invest hundreds of millions of dollars in irrigation and drainage infrastructure. Despite these investments, the irrigation schemes are not as successful as was hoped for. This paper discusses the outcomes of the multi-stakeholder and expert assessment of the capacity needs for ensuring sustainable irrigation and drainage systems. The assessment reveals that the unsuccessful story is due to several factors. First, most investments have not yet sufficiently factored in the user needs and operation and maintenance (O&M) requirements of irrigation schemes including resource mobilization (i.e., human, technical and financial) to support long-term sustainability of the irrigation schemes. Both resources for the professional management of primary and secondary main structures are significantly absent as currently there are only about 630 permanent staffs in the provincial water resources departments all over the country to manage over 700,000 hectares of irrigated area. In addition, the functional FWUCs and Agricultural Cooperatives for managing small scale irrigation system or field level irrigation schemes are small in number. The current US$ 2.6 billion Irrigation and Water Resources Investment Program (2019-2033) envisages for developing further irrigation schemes, knowledge management system and human capital to provide reliable irrigation to over 1,375,000 ha irrigated areas. Successfully operating and managing these irrigation schemes, Cambodia would need additional skilled staff between 1,600 to 2,200 (1 skilled staff per 600 to 900 ha) irrigation engineers, planner, and technicians to professionally plan for water allocation, conduct O&M of major and medium systems, and run the main components – reservoirs, main canals and secondary canals of the medium to large schemes. At the same time at least 250 self-sustaining and functional Water User Communities will be required to operate sustainable O&M at the water distribution canals level to reduce pressure on Government Budget and human capacity. Cambodia needs a well-funded and resourced capacity development program, for short, medium and long term.

Keywords: Adaptation strategies, Irrigation schemes, Climate change, Regional Climate Models, Crop water requirement.

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1. **INTRODUCTION**

Cambodia is located in Southeast Asia, sharing the border with Thailand at the north and northeast, Laos at the north, and Vietnam at the east. With the area of 181,035 km² and population around 16 million people, Cambodia is a country with sparse population density. The Mekong and Tonle Sap are the main water resources supplying water to serve all purposes, i.e. domestic use, hydropower, irrigation, tourism, fisheries.

Cambodia’s economic performance in recent years has been impressive, evidenced by high economic growth rates compared to global averages. The economy grew by 6.8 per cent in 2017 and is expected to grow by 7.1 per cent in 2018. Between 2007 and 2012, four million Cambodians were lifted out of poverty. Sixty per cent of this achievement can be attributed to agriculture and rural development (World Bank 2018).

Cambodia has shown much interest and investment in the irrigation sector. Since mid-2000s, over $1.3 to 1.6 billion were spent in rehabilitation of existing irrigation schemes and the construction of a few new irrigation schemes and reservoirs, both large and small(ADB 2018). Despite these investments, the irrigation schemes are not as successful as would be hoped for due to several underlying factors. In most cases, the capacity also needs to be increased in order to maintain and operate the systems properly. The current US$ 2.6 billion Irrigation and Water Resources Investment Program (2019-2033) envisages for developing further irrigation schemes, information management and human capital to provide reliable irrigation to over 1,375,000 ha irrigated areas.

In this paper, an assessment is performed in order to figure out the scope of informal and formal training needs for irrigation sector – irrigation management, design, construction, and operation and maintenance in Cambodia. The assessment is also focused on institutional and human capital issues for developing strategy and action plan for building and sustaining the required skills and relevant decentralized management structures.

2. **METHODS**

The study applies both qualitative and quantitative approach using both secondary data (literature review), and primary data (focus group discussion, face to face interview), as well as professional observation. The study also conducted an investigation in China to extract relevant lessons, since China has evolved through a similar path of irrigation development from the cultural revolution and process of continued improvement.

2.1 **Capacity Building Development Workshop and Seminar**

During this project, series of workshops and seminar were organized. The objectives were to bring all the stakeholders from the key Government Agencies at the national and provincial levels, key irrigation and water resources development programs, and researcher, together to discuss and find out the current situation of the existing irrigation schemes and all the skill and training needed to ensure scheme viability and sustainably. Questionnaires were provided to all the participants and divided into group to discuss and presented the answers to the workshop. The discussion groups were organized on their work description and level of responsibility from various institutions, provinces, or irrigation systems. The results of which are considered to be target specific for each management level.
2.2 Field Work

Fieldwork was conducted by the research team from the Institute of Technology of Cambodia, Royal University of Agriculture, Wuhan University, China and Cambodia Agriculture Value Chain Program (CAVAC) to investigate 05 irrigation and drainage projects which were completed and handed over to the local water administration and Farmer Water User Communities for management, such as

a. Kanghot in Battambang province (China’s loan),
b. Komping Pouy Scheme, Battambang (built in 1977 and rehabilitated by Japan, Korea, ADB/Australian Aid),
c. Stung Sreng (Banteay Meancheay, Oddor Meancheay, and Siem Reap) (China’s loan – 2014-2017),
d. Phnom Krom floodplain Reservoir (by Korean NGO) for recession rice in Siem Reap District and

e. CAVAC Ang Ko scheme and Farmer Water User Community– (Australian Aid) along Stung Sen river in Kompong Thom.

2.3 Interview with Multi-Stakeholders

Primary data was mainly obtained by the interview with the concerned stakeholders including senior irrigation and water planners in the Ministry of Water Resources and Meteorology (MOWRAM), Managers of the Provincial Department of Water Resources and Meteorology (PDOWRAM), Operators and Planners of the Irrigation Schemes, and relevant development partners such as the Asian Development Bank, French Development Agency, Japan International Cooperation Agency, Local NGOs (Irrigation Service Center (ISC) and Water User Network etc.. The data include the inventory of the irrigation scheme, human capital and capacity needs, water availability, command area, cost for construction and O&M, crop types, agricultural practices, policy and management, challenges (technical, human resources, budget, administrative), and livelihood of local people.

3. RESULTS AND DISCUSSION

3.1 Key Stakeholders in Irrigation Water Management In Cambodia

Irrigation management in Cambodia has involved with many stakeholders at multiple levels. For efficient building capacity, there is a need to mapping the involved or concerned stakeholders and their capacity gaps. The stakeholders involved in irrigation system management and development comprise (FAO 2002, Phirun, Hirsch, and Connell 2011, Pech and Ranamukhaarachchi 2013): At national level: Ministry of Water Resources and Meteorology (MOWRAM), Forestry and Fisheries (MAFF), the Ministry of Rural Development (MRD), the Ministry of Environment (MOE), and the Ministry of Economic and Finance (MEF); Sub-national level: Provincial Department of Water Resources Management and Meteorology (PDOWRAM), local authorities; Scheme Level: Farmer Water User Communities (FWUCs), Farmer Water User Groups. Donors: World Bank, the Asian Development Bank (ADB), the IMF, KOICA (from South Korea), Agence Française de Development (AFD) and various UN agencies. NGOs: GRET, CEDAC, and others listed in (FAO 2002).

The detail functions, risks and the stakeholder analysis can be found in (ADB 2015,Phirun, Hirsch, and Connell 2011).
3.2 Assessment of Some Existing Irrigation Schemes

Kanghot Irrigation Scheme

Located in Battambang province, the Kanghot irrigation scheme is one of the irrigation development projects under China’s loan. The irrigation scheme is composed of three key projects: Kanghot Irrigation Development Phase 1, Kanghot Irrigation Development Phase 2, and Kanghot Multi-purpose Reservoir. The maximum storage capacity is 286 million cubic meter (MCM). The reservoir and irrigation scheme are capable to supply water to 47,000 hectares (ha) and 12,000 ha in rainy season and dry season, respectively. A remarkable challenge on water management experiencing at Kanghot Irrigation Scheme is the outpace of water demand to the supply ability but not due to the water shortage in the reservoir. The reservoir can respond to the increasing need but significant absence and incompleteness of the canal schemes to the farm level which fail to distribute water. Farmers have been expanding farming areas and shifting to cultivate more than one crop. The phase 1 project was designed and planned for irrigating only 8,000 ha while the actual cultivated area has been increasing to 18,000 ha. The underestimate of the demand is ascribed to failure to assess and evaluate the relevance of the project and needs of the farmers.

There are 4 PDOWRAM staffs have been assigned to control and operate the main sluice gate and several kilometers of this large-scale irrigation scheme. On average, each staff has to run over 15,000 ha of command area which is far higher to guarantee a good management of the scheme. At this scale of irrigation scheme, a functional FWUCs to manage the distribution of water at the farm level canal and collection of ISF is necessary to sustain the scheme. However, the FWUCs in this irrigation scheme is weak and incapable of collecting ISF. It is a typical situation for most of the irrigation schemes run by MOWRAM in other places.

Kampingpouy Irrigation Scheme

The Kampingpouy Dam is located in Battambang province thirty-five kilometers west of Battambang city. The dam is six meters high and 1,900 meters in length. The reservoir covers about 4,800 ha with full capacity of 110 MCM. Sedimentation and siltation shallow the reservoir to an average depth of 2.5 meters. The water is used primarily for agriculture in the surrounding area. The water supplies and irrigates to three districts (Banan, Battambang, and TmarKol). The reservoir has been rehabilitated several times since its completion.

The dam was severely damaged in October 2013. It was caused by the flooding and mismanagement and poor decision-making process, as well as lack of proper advance flood warning and short handedness of staff. It is one of experiences and lessons for management institutions (MOWRAM and MEF). MOWRAM and MEF have been struggling in allocating more resources (budget, technique, and staff) for a proper management of the infrastructure to secure a long-term benefit from multi-million dollars of investment/loans through improving better informed and timely decision-making. The Kampingpouy scheme irrigates approximate 10,000 ha in wet season and 5,500 ha in dry season. However, PDOWRAM does not have sufficient resources to maintain good management of the scheme. Under-staffing and lack of resources are the main challenges.

Stung Sreng Scheme

Located in Oddor Meanchey province, Stung Sreng Water Resource Development Project-Phase I and II were developed by Sinohydro Corporation Limited under
China’s loan. The project covers the extent area of three districts: Chongkal district of Oddor Meanchey, SreySnom district of Siem Reap, and Phnom Srok District of Banteay Meanchey. It provides water for irrigation, clean water supply, and flood control measure.

Whole PDOWRAM of Oddor Meanchey province has 23 staffs (both full and part-time staff), 10 of which have been assigned to run the main sluice gate and several kilometers of irrigation canal within the province. Due to lack of financial resources, MEF limits the recruitment of more staff to PDOWRAM. New staff is recruited at the rate of the replacement only despite the request from PDOWRAM and its lack of human resources. In addition, more training and skill development program is necessary to build capacity of the current staff.

MAFF/PDAFF Recession rice

The Phnom Krom Agricultural Cooperative (PKAC) is located in Siem Reap province, about 7 kilometers from the Siem Reap City. PKAC practices recession rice and dry season irrigation techniques which are widely used in the Tonle Sap flood plain. This 8 km long polder was created in 1977 during the Khmer Rouge Regime, and rehabilitated by the Korean NGO. In the last decade, farmers have moved away from the floating rice to recession rice. The recession rice irrigation practices are becoming common within the Tonle Sap flood plain and reservoirs. This practice generates a high yield by increasing the agricultural inputs especially with applied chemical fertilizers and pesticides indeed with the expense of other environmental concern for the ecosystem and biodiversity. The flood plain experiences full inundation annually which requires maintenance and rehabilitation after the end of flooding. There is an AC committee but ISF has never been collected. Therefore, AC committee is not able to maintain a self-sustained financial support. The expense of the rehabilitation, i.e. small scale fixing to the dike and water gates, is relying on the donation. Dike-polder system is useful for water storage, but improvement is needed to the prevent the annual recurrence damage by flooding. The replacement of earthen structure with concrete structure is a possible solution but considered as financially nonviable for PKAC to handle.

CAVAC 1 Ang Ko Irrigation Scheme

This irrigation scheme is located in Kompong Thom province. Angko is one of the four irrigation schemes (built and handed over to FWUCs since 2015. With irrigated area less than 5,000 ha, Ang Ko scheme is considered to be medium size. The rice yield is around 6 metric tons/ha the amount of which is larger than the profit margin (above 3 metric tons of cost recovery). There is still available potential marginal benefit by lowering the operational cost. Water saving, good irrigated schedule, and proper maintenance of pump are best example measures to lower the operational cost.

Ang Ko irrigation scheme is considered to be a success. The scheme has been managed by the local FWUC with minimal support from PDOWRAM for the last 4 years. FWUC is able to collect ISF up to around 97%. The farmers normally need to pay 75 USD/ha but 100 USD/ha for those who need the second lift to pump water into their field. FWUC shows a strong financial management with over 100 million riels (approximately 25,000 USD) are saved in FWUC bank account and another 29,000 USD investment in two additional pumps and storage facilities. These are the indicators of a strong sustainability of the project.
3.3 Key Findings of Capacity Building in Irrigation Management in Cambodia

3.3.1 Capacity Building Gaps and Needs

The aspect of capacity building is the supply of human resources (Hamdy and Lacirignola 1997). The need for adequately trained professionals in water resources and irrigation management in Cambodia is a structural issue. ADB 2012 indicated also that the weak and insufficient capacity of human resource in all levels of the irrigation management is the primary cause of the slow rural development in Cambodia. The capacity building can be performed through education, training, workshop, etc. The detail methods and tools for Capacity Building can be consulted in Manual Capacity Development of ADC 2011. The challenges and needs for Capacity building in the irrigation sector in Cambodia are described in following.

Education

Regarding to the education quality, Cambodia ranks 124th in higher education and training, its poorest performance in pillars of the basic requirements for global competitiveness (WEF 2017). The major cause of poor education and research capacities are the inadequacy of budgets and qualified educators and researchers, and poor incentives, as well as the lack of supporting infrastructure, such as research facilities, laboratories and copyright regulations and nepotism and patronage. UNESCO (2011) points to the instances of politicizing education and science. The knowledge and skills provided in universities partially do not match the needs of the Cambodian labour market (Sam 2016).

Studies on commerce, economics and information technology are the most popular programs among Cambodian students as their expectation is to get a well-paid job in an air-conditioned office in these areas (Damico 2010, Madhur 2014, Samuels 2018). However, these employment areas are saturated and the big labour market gaps are the qualified graduates in science, mathematics, agriculture and health and especially the irrigation engineering. In 2009/10, among the students enrolled for graduate degrees in the Cambodia, about 10 percent enrolled for business management, another 6 % for medicine, nursing and pharmacology, about 6 % for computer science, less than 3 % for engineering, 1.4 percent for science and 1.3 % for mathematics (Sothy et al. 2015). In the next 10-14 years, Cambodia is facing with the growing demand of irrigation engineers for water management, planning and operating. The question poses for decision makers on how to produce the irrigation engineers to meet the growing demands in the next decades.

At the moment, there are few technical institutes in Cambodia to produce the engineers and only Institute of Technology of Cambodia that focuses on producing rural and irrigation engineers. This is because the technical institutes require a larger practical work, especially field work and on-the-job training and the required facilities (equipment, laboratories and qualified staffs) and furthermore with small number of students (Damico 2010). From a lack of government funding, public universities are unable to increase enrolments in science and engineering programs to absorb more students (Samuels 2018). To popularize engineering and science among young Cambodians, especially for the irrigation and rural development fields, more investment and funding are needed from government or donors in the technical institutes.

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UNESCO, 2011, Education and Fragility in Cambodia, International Institute for Educational Planning, Paris France
Another aspect on how to encourage graduates to work in agriculture and rural development is another challenge for the Cambodian government. Finding new job opportunities in irrigation area with no strong job-network are constraint for young irrigation engineers. The recruit for rural engineers is few. According to the interview with the rural staffs, the irrigation engineers have faced many constraints at working in rural areas. The first is that most of the young engineers will receive low salaries to work there. The second thing is there are no sufficient facilities such as good rural roads, communication and being far from family home. Consequently, some have abandoned their rural jobs to look for the other job opportunities that have higher salaries or benefits. They suggested that payment of higher salaries and emoluments to those working in rural areas are the greatest motivation for them.

Promoting more job opportunities in rural areas by the government or donors is another solution for the Cambodian young graduates. Some good practices have been indicated by GIZ 2019. GIZ (2019) has promoted sustainable agriculture and rural development in Tunisia by encouraging young people developing their own business projects, with a particular focus on the targeted use of innovative agricultural and communication technologies. Regarding to this aspect, the technical universities should provide some courses related to entrepreneurship and leadership for the students.

Research and innovation

In the top-down decision driven, there is a need of science driven. How to build a scientifically informed decision making is required in the higher management level. The capacity building of research evident based is needed. The capacity to undertake research is vitally important in irrigated agriculture (FAO 2004). However, research is virtually absent from Cambodian universities (UNESCO 2011). Generally, academic staffs in universities and doctoral students conduct research and publish scientific papers (UNESCO 2011). Major obstacles to their active research included limited access to books or journals, time constraints, poor knowledge of research methods, insufficient institutional support and low salary. Therefore, most of academic staffs do not prefer research activities. Evidently, publications of lecturers in the higher education institutions remains very scare (Madhur 2014).

Research and innovation are the main driver for economic growth and social development (Nyamekye 2010, OECD 2007). It plays crucial role in creating new ways for doing more by using less resources and energy inputs (Clune and Zehnder 2018). Overall innovation capacity of Cambodia received a relatively low score, standing globally at 118th in 2017 and stays far from the neighbour countries such as Vietnam and Thailand are at 84 and 47 respectively (WEF 2017). To meet the goal to become an upper-middle income country by 2030 and a high-income economy by 2050 (RGC 2013), Cambodia requires a serious and hard capacity building and focusing on research development undertakings in universities and other research institutions.

Modernization and innovation can help Cambodia to overcome the capacity gaps in qualified water management expertise and skills. Policymakers must fund and improve research capacity. The detail needs and gaps for capacity building in irrigation sector can be found in World Bank 2017.

3.3.2 Sustainable Capacity Building

The sustainable development is process of changes depending on local contexts, needs and interests but the common process is by consideration of the balance of its three pillars: social, environmental and economic or people, planet and profit (UNESCO 2017, Clune and Zehnder 2018). This concept of integrated water resources management (IWRM) has been applied in the irrigation development
Cambodia. However, the insufficient capacity of the all management levels are the major constraints itself (Jens 2010). The framework for capacity building process for sustainable irrigation in Cambodia are proposed as in the Figure 1. The efforts and tasks should be focused are following:

- The primary action should focus on the detail assessment of capacity needs of all levels of stakeholders in order to identify gaps in the irrigation management. The needs identified will help to inform the formulation of Strategic Capacity Building Plans to address those gaps and also to identify this priority.
- The activities of Capacity Building should have the clear conceptual framework. An good example proposed by FAO (FAO 2004) is recommended.
- The good standard salaries or motivation of the academic and irrigation staffs (financial incentives), especially in the irrigation field should be priority enhanced.
- National irrigation expert teams or committees with good quality living standard and sufficient number should be established for national irrigation standard design, quality control, innovation, providing the strategic action plans specifically in the irrigation development and searching for effective Capacity Building tools to create knowledge for all stakeholders. The team should be supported from the international irrigation experts.
- A more in-depth investment in qualified graduate and postgraduate education in water resources management and specifically in irrigation at national or international training and education institutes is required to meet the growing demand (FAO 2004).
- Training quality assurance: In order to enhance the quality of education and training delivery and the motivation of providers of these services to deliver quality training, a quality assurance system needs to be introduced and strengthened. Standards and procedures for certificates need to be developed (FAO 2004).
- To avoid inadequate resources, poorly-trained and poorly-motivated staff, and a lack of clear direction as to their contribution to local and national interests, it should try to select the most appropriate research team for funding (FAO 2004).
- The government should allocate more public budget and make serious efforts to nurture and support for research and development to the technical universities and research institutions.
- National capacity building network: for sustainability, the principle of IWRM should be enhanced and understood in-depth efficiency at all levels of irrigation sectors. In this aspect, the empowerment of women needs to be focused in the system.
- The training-focus should be prioritized to the up-to-date technologies and innovation for long term irrigation management. These should include pinning on the integrated information management system (monitoring weather and water availability for water use planning and dam safety), systematic water demand survey, automation for their management efficiency improvement, advanced GIS, Drone and remote-sensing.
- The coordination and linkages between MOWRAM and MAFF need to be strengthened so that there is seamless support from source to field with regards to water delivery, water-management, and agricultural production (World Bank 2017).
- Strengthen government agencies. Based on a detailed assessment the number, level and skill of staff can be determined. Increase in staffing is especially required at provincial level. The actual number and level of staff will depend to a certain extent on the speed of irrigation development (World Bank 2017).

- Increased participation of the private sector. Depending on the pace of irrigation sector development, certain private sector participation to carry out feasibility studies, prepare designs and tender documents, and carry out construction supervision will be necessary (World Bank 2017).

- Measures to help young professionals build careers in the water resources and irrigation sector. It is seen as essential that Cambodia becomes self-sustaining and strengthens the professional capacity within the country rather than having to rely on external technical expertise (World Bank 2017).

Figure 1. Framework for capacity building for sustainable irrigation development in Cambodia

4. CONCLUSIONS

This paper has revealed the current challenges in water resources management and irrigation development project in Cambodia. Despite the tremendous effort from the Royal Government of Cambodia and international development partners with over $1.3 to 1.6 billion investment, the irrigation projects still confront with unsuccessful stories. It is ascribed the failures of irrigation scheme in Cambodia to lack of human resources, insufficient cost recovery and inadequate maintenance, lack of national design standard, and missing public support and participation. It is found that several capacity building programs to all the concerning stakeholders are the essential link to efficient and sustainable irrigation projects. Education system at university level to produce qualified human resource as well the technical and professional training is necessary to be well prepared to cope with challenges in irrigation problems. These capacity building programs also contribute to raise the awareness of people and emphasize their important role in all the projects as early as the initiation of the project. All the stakeholders must arrive at one common perception and be ascertained that water to some degree is treated as “commodities” by which all the projects will be assured to be sustainable in term of economics. In addition, national design standard is a pivot tool in fine-tuning the relevance, effectiveness, efficiency, and sustainability of the project in terms of Cambodian unique geographical characteristics.
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