Agricultural Water Storage Options for Climate Change Adaptation in Cambodia

Introduction

> Now and in the future, agriculture and food security depend on managing water – a finite resource, but variable in time and space. (McCornick et al. 2013)

For an agrarian society like Cambodia, the topic of climate change is very compelling. Agricultural production is predominantly rainfed with a lower percentage of cultivable land that has access to water for irrigation, mainly for supplementary use in the wet season. Within the context of climate change, the impacts on agriculture are exemplified by the pressure on water resources particularly in terms of water flow, rainfall, flood and drought (MOE and UNDP 2011).

Many studies on regional and national scales have indicated that the hydrological regime of the Mekong River, upon which agriculture relies, is likely to change in terms of flow (MRC 2010; TKK and SEA START RC 2009). Other impacts include changes in the seasonal volume, distribution and intensity of rainfall. Many agricultural areas in the country are vulnerable to drought, and high evaporation due to increased temperature is expected. Furthermore, the frequency and extent of flood and drought are predicted to increase (MOE 2010; Clausen 2009; Eastham et al. 2008; Fraiture et al. 2007).

Climate change impacts vary in different parts of the country, however. For example, while high volumes of rainfall are disastrous for wetter areas, they are beneficial to drier areas (Eastham et al. 2008). These climate predictions are endorsed by the current conditions, specifically in terms of extreme weather events, soil fertility and limited access to irrigation (MOE and UNDP 2011). It should be noted that climate change is not the sole reason for the changes that are being experienced in the agriculture sector: development activities such as hydropower dams are also having an impact.

Adaptation strategy in the water sector to cope with climate change has focused on water storage options that aim to promote both agricultural productivity and food security, specifically for the poor (McCartney and Smakhtin 2010). If water is

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A community pond has been dug by local community members working collectively to cope with irregular rainfall at the end of the wet season, Pursat province, November 2013 stored in the wet season, agriculture in the dry season is feasible, water-scarce areas can access water through diverting it from the storage facility, and water shortage resulting from alterations in rainfall and flow is ameliorated (McCornick et al. 2013). The pros and cons of the water storage options and their sensitivity to climate change must therefore be considered (McCornick et al. 2013).

In Cambodia, besides irrigation structures that are a method of water storage for agricultural purposes, there are other viable options (Johnston et al. 2013). For instance, a study commissioned by Dan Church Aid/Christian Aid in 2013 examined the significance of the different agricultural water storage options to help reduce vulnerability to drought and prolonged dry spells throughout the four main agro-ecological zones. This article will review these existing agricultural water storage options, identify challenges and opportunities presented by each, and suggest approaches to enhance the options to help farmers to adapt to the challenges posed by the changing climate.

Data Collection and Methods

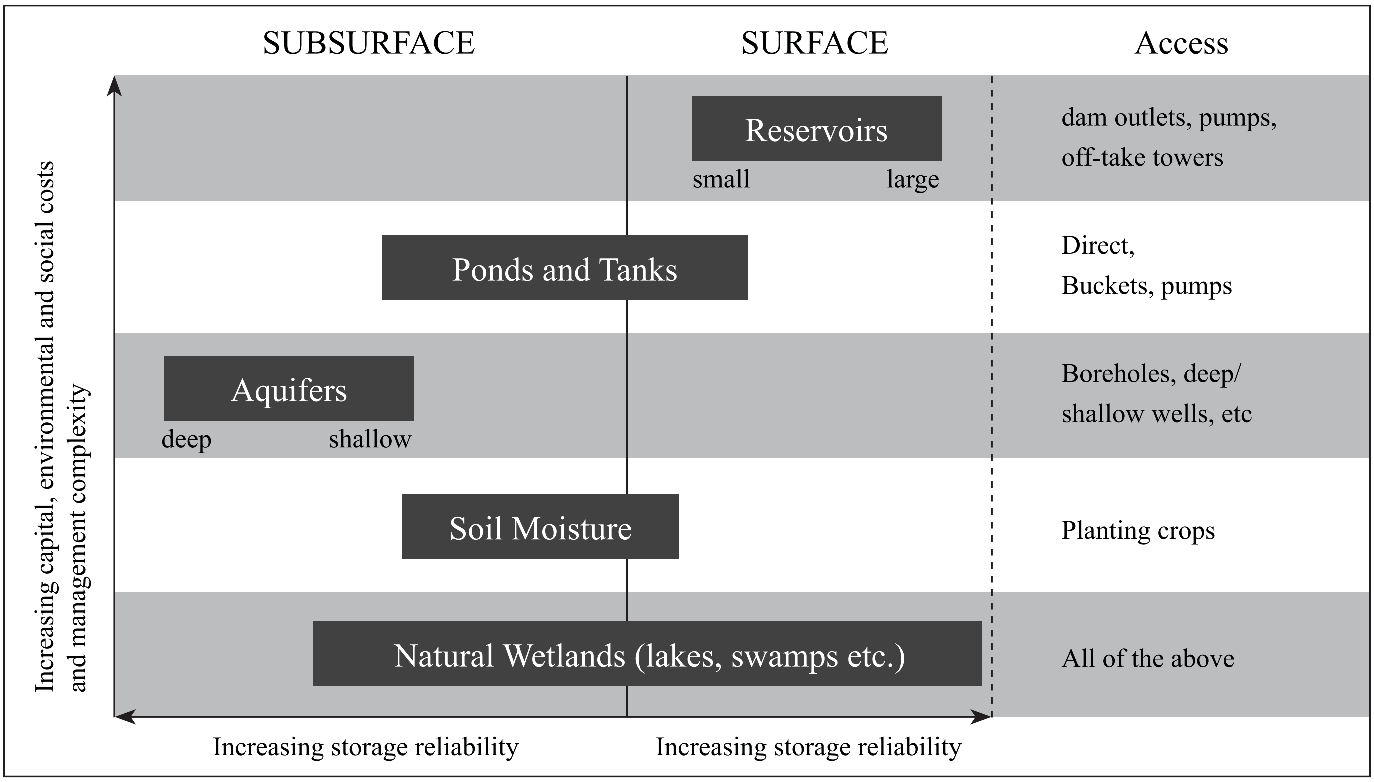
Two main agro-ecological zones of Cambodia – the Tonle Sap and Lower Mekong plains – were selected for the study. For the Tonle Sap zone, Pursat, Kampong Thom and Kampong Chhnang were the target provinces, while Takeo and Prey Veng provinces were chosen to represent the Lower Mekong zone. Representatives from the Provincial Department of Water Resources and Meteorology (PDOWRAM) and the Provincial Department of Agriculture (PDA) in each province were selected for key informant interviews (KIIs), and one commune[1] within each province was chosen as the location for focus group discussion (FGD). The participants of the FGDs included commune councillors, farmer water user community (FWUC)[2] members, village chiefs and villagers. This study is also based on existing information and data on policy, plans and local practices retrieved from both online sources and from documents.

This study employs the concept of the physical water storage option continuum published by the International Water Management Institute (IWMI) in 2010. The continuum centres on both surface and subsurface water resources (Figure 1).

[1] Those communes include Svay Daunkeo (Pursat), Ou Kanthor (Kampong Thom), Thlok Vien (Kampong Chhnang), Phnom Den (Takeo) and Ansaong (Prey Veng).

[2] FWUCs involved in the study included Plov Touk (Plovic) of Takeo, and Roluos of Kampong Thom.

Figure 1: Conceptualisation of the Physical Water Storage Options



Source: McCartney et al. 2010

Existing Agricultural Water Storage Options

Based on the Commune Database of the National Committee for Sub-National Democratic Development (NCDD 2014), the total irrigated areas in the wet season were rather small throughout the two zones. And according to an inventory in 13 provinces conducted by the Cambodian Center for Study and Development in Agriculture (CEDAC) in 2009, only 6 percent of the total 2525 irrigation schemes were fully functional and a substantial 65 percent were dysfunctional.

Within the irrigated areas, irrigation water is used to compensate for water shortage resulting from the short dry spell within the wet season.[3] Although the majority of agricultural production is rainfed, production in the dry season is undertaken in some areas that have access to water, mainly from irrigation schemes.

Among the five provinces visited for this project, irrigation water comes mostly from canals/dams[4] with natural streams/ponds acting as a secondary source (Table 1). The communes visited in Kampong Thom, Takeo and Pursat obtain irrigation water through canals that divert water from local rivers. These canals are operated by FWUCs in collaboration with PDOWRAM.

Drilled wells are most prevalent in the Lower Mekong zone, and the two provinces visited were both found to have drilled wells for agricultural purposes. The number of wells keeps increasing (Table 2). The water table is reported to be lower than before: according to discussions with the local people of Ansaong commune, wells are getting deeper. However, this has occurred in just a few places so far, and there is, as yet, no scientific evidence to support this claim.

Public-private partnerships in irrigation management and governance have been started with the arrival of private pumping activities in FWUCs. In Takeo province, where an FWUC collaborates with a private irrigation pump owner to help farmers to channel water from the canal, this has been very successful in sustaining not only the FWUC but also in boosting agricultural productivity.

Areas irrigated by rivers, streams and natural ponds were found in Thlork Vien commune of Kampong Chhnang. Local people grow rice and vegetables along streams and around ponds but they have to adapt to floodwater after heavy rainfall. The other source of water for irrigation in Cambodia is from dug ponds. The NCDD Commune Database (Table 1) shows that only Pursat has increased the

[3] Lasting about two weeks in the wet season, usually between July and August.

[4] Canal systems are used to divert water from rivers and streams through diversion weirs.

Table 1: Sources of Irrigation Water for the Wet Season (%), 2008–10

Zone	Province	Year	Area of irrigated rice land*	Area irrigated from canals/dams**	Area irrigated from rivers, streams, natural ponds**	Area irrigated from drilled wells**	Area irrigated from dug ponds**
Tonle Sap plain	KCH	2008	16.67	61.42	30.05	7.58	0.15
		2009	20.03	76.13	23.70	0.10	0.08
		2010	13.38	61.84	37.38	0.00	0.79
	KTH	2008	8.78	94.73	5.26	0.00	0.01
		2009	11.10	75.87	24.03	0.00	0.01
		2010	7.22	79.98	19.83	0.14	0.05
	PS	2008	14.47	71.77	27.96	0.00	0.27
		2009	15.58	76.62	14.69	0.00	8.69
		2010	14.67	81.5	10.20	0.05	8.24
Lower Mekong	PV	2008	12.55	61.12	21.02	17.18	0.67
		2009	14.08	62.43	20.11	16.54	0.92
		2010	14.58	62.91	18.72	17.66	0.71
	TK	2008	9.23	66.67	13.32	11.51	8.50
		2009	5.74	74.81	21.91	2.94	0.34
		2010	0.41	62.20	32.65	4.76	0.34

KCH=Kampong Chhnang, KTH= Kampong Thom, PS=Pursat, PV=Prey Veng, TK= Takeo

Note: * percentage of total rice cultivation area; ** percentage of total irrigated area

Source: NCDD (2014)

Table 2: Agricultural Wells, 2008–2010

Province	2008	2009	2010
KCH	255	346	191
KTH	57	264	328
PS	43	81	42
PV	14467	15412	17395
TK	2052	2354	2523

KCH=Kampong Chhnang, KTH= Kampong Thom, PS=Pursat, PV=Prey Veng, TK= Takeo
Source: NCDD (2014)

amount of irrigation water taken from ponds: the field visit also verified this data. Local people of Svay Daunkeo commune have dug ponds in their fields to ensure a sufficient supply of water to compensate for the change in the rainfall pattern.

Soil water conservation methods have also been applied. These involve composting, mulching, crop rotation, cover crops, the System of Rice Intensification (SRI), multi-purpose farming (MPF), and earth bunds. Provincial Departments of Agriculture (PDAs) and many NGOs have been conducting activities to improve these techniques by working with the farmers directly.

Challenges and Opportunities

Although each type of storage corresponds to IWMI suggestions, they are still exposed to many internal and/or external challenges. To start with internal challenges, the capacity of FWUCs in managing their part of the irrigation process has always been problematic in respect of adopting a more participatory approach. There is some support in terms of capacity building but this has been insufficient, especially since such assistance is available only during a project implementation period and there is neither follow-up nor ongoing assistance. Almost all of the FWUCs have been unable to collect sufficient irrigation service fees (ISFs) to cover the costs of operations and maintenance (O&M) and the government's financial support is limited. However, the Plovic FWUC in Takeo province is considered a success in terms of ISF collection for O&M. It should be noted that this area is on the border with Vietnam with access to markets and technology to boost productivity and, for that reason, farmers can afford ISFs.

Social capital[5] is also a crucial component in both the construction/establishment and operation of water storage options, but this is restricted due to low incentives in collective work, limited understanding about the benefits of collective action, and limited time and labour. Local practices specifically impede the adoption of the soil moisture retention option. There is no system of grazing. Some local people leave their animals free to graze during the dry season, making it is hard for others to benefit from cover cropping, an important water and soil conservation strategy.

Another internal challenge is the lack of local resources including funds and land available for communal use on a local scale such as for digging community ponds. Although local authorities at the commune level have their own funds in the form of the Commune Investment Fund (CIF), those are still inadequate since some types of water storage are costly. It also seems that local people depend significantly on external support, making a lot less effort to devise local alternative resource mobilisation strategies such as pooling their labour to construct water storage structures. Land that is suitable for community water storage, i.e. located near cultivated areas, might be hard to find. Yet it is virtually impossible for farmers to build individual water storage facilities given that they own only small areas of land and in diverse locations. The nature of the soil is also a challenge to the functioning of canals/dams and ponds through its high infiltration capacity, which hampers soil moisture retention and water storage.

External factors also pose challenges to storage options. To begin with, there are not many irrigation water supply structures, making it very difficult to implement the options suggested. From the local data in Table 1 and from CEDAC's assessment, it is clear that the number of fully functional structures in Cambodia to ensure sufficient water supply is limited. Meagre resources including financial, technical, legal and regulatory are another obstacle to diverse water storage options. Support is needed for two major elements: the construction of water storage structures, and then O&M. There are currently few functional structures specifically designed for irrigation schemes and ponds, while,

[5] Defined as "the features of social organizations, such as networks, norms and trust that facilitate coordination and cooperation for mutual benefit" (Putnam et al. 1993: 67).

in terms of O&M, performance has been poor.

It is the case that irrigation schemes receive considerable attention within national policies such as the Strategy on Agriculture and Water (SAW), although options such as ponds and soil water conservation are more of a focus for development partners and NGOs. Local authorities are responsible for natural lakes and ponds, but some pressures are infringing on these resources, for instance, land encroachment for agricultural purposes. With respect to legal and regulatory issues, specifically for groundwater, there are no regulations to support sustainability in extracting this renewable resource. There is neither a ban nor any encouragement for people to restrict the amount of water they draw.

Despite these challenges, Cambodia has many opportunities to take action. One is climate finance[6] and a total of USD655.6 million has been mobilised in Cambodia since 2003 through bilateral[7] and multilateral[8] financing. The fund is chiefly available as grants and, to a lesser extent, concessional loans, and around 41 percent has been spent on the agriculture, water and irrigation sectors. The agro-ecological zone that has requested a particularly substantial fund is the Tonle Sap, with Pursat as the largest receiver (Enrich Institute for Sustainable Development 2014). The fund is mobilised at national, subnational and local levels through various projects.

In addition to support funding, climate change adaptation measures and relevant policies have been formulated as can be seen in the Cambodia Climate Change Strategic Plan (CCCSP). Apart from this, local communities have also been granted a significant role that could reap dividends: on the one hand, social capital and collective action are challenges in realising water storage options; but on the other hand, they have an invaluable role in ensuring the sustainability of the options as well as being vital local resources. Many reports have highlighted the roles of the local community in climate change adaptation, whether or not funds are available. It is also important to realise that although funds might be available and project interventions are in place, the sustainability and success of the project depends a lot on the determination and competence of the local community.

Applicable Approaches: Making Agricultural Water Storage an Effective Adaptation Strategy to Combat Climate Change

It is wise to take into account both the challenges and opportunities for creating realistic approaches to water storage. An enabling environment covering physical, technical, financial, legal, regulatory and social aspects has to be created. It has, for instance, to be accepted that there is no "one size fits all" solution. In terms of physical aspects, soil suitability must be taken into account in decisions about feasible water storage. Both internal and external supports also play a crucial role and can increase the number of viable storage options.

Internal support comes from local institutions such as local authorities, communities and people. Communes can, collectively, use their CIFs to build small reservoirs and/or canals and dig communal ponds. Local communities such as FWUCs can also mobilise farmers to build structures according to their capacity while local people themselves can dig their own ponds or share part of their land for pond digging.

External support comes from government, NGOs and development partners, which tend to have access to much larger amounts of funding. Such finance can be substantial in supporting the construction of a whole irrigation system or on a smaller scale that stretches only to the building of small structures. The key issue to be noted is that support has to correspond to the real need of the locality.

In term of soil suitability, since each specific area has specific conditions such as soil slope and infiltration rates, each option has to match these, too. For example, as the Tonle Sap zone receives an annual flood, reservoirs might be the best option but the system has to be adapted to possible inundation when the flow of water is excessive.

The technical aspects of water storage options

6 "Climate finance is the financing channeled by national, regional and international entities for climate change mitigation and adaptation projects and programs" (Enrich Institute for Sustainable Development 2014: 2).

7 Such as Japan, France, the US, China, the EU and Australia (Enrich Institute for Sustainable Development 2014).

8 Such as Asian Development Bank (ADB) World Bank, Global Environment Facility (GEF), International Fund for Agricultural Development (IFAD), United Nations Development Programme (UNDP) and the Food and Agriculture Organization (FAO) (Enrich Institute for Sustainable Development 2014).

relate to know-how, which is vital in enabling benefits to be reaped. The best approach is to combine indigenous with scientific knowledge, and it should be simple so that it can be easily grasped and used by local people: local community members are key in decisions about the management of all water storage options. The channels through which such knowledge is shared should comprise three modes: NGOs, local institutions and social networking. Many NGOs have been working on transferring knowledge about irrigation management and soil moisture conservation, and the possible channels for sharing are local institutions. Social networking, consisting of neighbours and family members, also plays a role in disseminating such knowledge.

Financial aspects make a major contribution to the sustainability of water storage infrastructure management and governance. Many failures in the management of irrigation schemes have been attributed to inadequacies in budget. It has been a big challenge to find sufficient resources since the country is developing and there are many calls on often limited resources. However, there are still ways. Local people often depend on external assistance either from the government or NGOs and development partners and this trend has hampered them in achieving self-sufficiency. Seeing this, NGOs have, for instance, started local savings groups aiming at accumulating funds that participants can use for agricultural spending. So, with the government focusing on medium- and larger-scale water storage options, local people, with assistance from NGOs and development partners, can afford to build smaller scale water storage options.

Securing access to water through smaller-scale water storage options can be enhanced given appropriate legal support. Since the current legal or regulatory support concentrates mainly on large-scale irrigation infrastructure, this needs to be widened to embrace other options to attract the interest of not only the government but also NGOs and development partners. Local people can also take advantage of social capital to secure access to water. They can work together to make things happen in their community, thereby reducing their dependence on external support. They can help reduce the cost of constructing and maintaining water structures by contributing their labour and sharing parts of their land. However, before this situation can be realised, both NGOs and local authorities must play a role in motivating local people and marshalling activity in the locality.

These components are distinct, yet interrelated, and together they can build an effective enabling environment for agricultural water storage options in Cambodia.

Conclusion

The review and identification of existing agricultural water storage options provides an up-to-date picture for understanding the current situation, challenges and opportunities in Cambodia in terms of water storage. Overall, the realisation of options is on track in respect of suggestions made by institutions at regional and global levels.

Cambodia already has diverse agricultural water storage options, but needs more practical support. However, with the current availability of climate change financing, the country has a chance to make substantial progress if it moves swiftly and wisely.

What is needed is the establishment of resilient local communities, with the capacity to understand the strengths and weaknesses of each water storage option and an appreciation of how vulnerable each is to the impact of climate change. Local communities should not simply rely on external support, but should mobilise their own resources. In the short term, external support has to be in place from organisations that will work cooperatively with local farmers and mainstream knowledge along the way to make sure those people are capable of sustaining their own livelihoods in the context of climate change.

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