Moving Forward Cambodia's Response to Climate Change

Learning from the CCCA Grant Projects to Improve Climate Change Programming in Cambodia

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National Council for Sustainable Development
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Abbreviations and acronyms

CC	Climate change
CCCA	Cambodia Climate Change Alliance
CRDT	Cambodia Rural Development Team
CRVA	Climate Risk and Vulnerability Assessment
ESCO	Energy Service Company
GERES	Group for the Environment, Renewable Energy and Solidarity
GSSD	General Secretariat of NCSD
KAS	Konrad-Adenauer Stiftung/ German Political Foundation
MAFF	Ministry of Agriculture, Forestry and Fisheries
MIH	Ministry of Industry and Handicraft
MME	Ministry of Mines and Energy
MoE	Ministry of Environment
MoEYS	Ministry of Education, Youth and Sport
MoH	Ministry of Health
MRD	Ministry of Rural Development
MoT	Ministry of Tourism
NBP	National Biodigester Program
NCSD	National Council for Sustainable Development
NCDM	National Committee for Disaster Management
O&M	Operations and Maintenance
PDOE	Provincial Department of Environment
R&D	Research and Development
UNDP	United Nations Development Programme

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Representatives of a large number of project beneficiaries, project implementing agencies, line ministries and other stakeholders provided information through individual interviews and participation in consultations on this report.

The opinions and recommendations expressed in this report are those of the author and do not necessarily represent the views of NCSD or CCCA donors.

Background and Purpose

This report aims at documenting, reviewing and discussing a broad range of programming aspects related to 22 grant-financed projects implemented between 2015 and 2019 and funded by the Cambodia Climate Change Alliance (CCCA).

The CCCA Phase 2 is an initiative led by the Ministry of Environment / National Council for Sustainable Development and supported by the European Union, Sweden and UNDP. The overall objective is to strengthen national systems and capacities to support the coordination and implementation of Cambodia's climate change response, contributing to a greener, low carbon, climate-resilient, equitable, sustainable and knowledge-based society.

CCCA has operated a grant facility funding climate change adaptation and mitigation projects in the field. Window 1 of the grant facility provides support to demonstration projects implemented by Government agencies in line with their Climate Change Action Plans (CCAP), while Window 3 funds innovative projects from both civil society and the public sector. A total of USD 4.45 million have been allocated to 22 projects between 2015 and 2019 (14 under window 1 and 8 under window 3). Projects cover a wide range of activities and sectors. More detailed descriptions of each project are available online: window 1 and window 3.

The observations made and conclusions drawn in this report are based on a series of interviews and group discussions with beneficiaries; staff of implementing agencies and relevant ministries; observations during project visits (that took place in April and May 2019) as well as an extensive review of project documents such as proposals, progress reports, evaluation reports, economic analysis reports and other knowledge products by projects. Recommendations are made in view of improvements in programming approaches used for future climate change programs and policies in Cambodia, e.g. CCCA phase 3. The three cross-cutting themes that the subsequent chapters focus on have been agreed with the CCCA secretariat as key learning areas. They will be supplemented by four case studies concentrating on the following topics: 1) innovative approaches to capacity-building and awareness raising, beyond training; 2) promotion and adoption of low carbon technologies; 3) innovative approaches to stakeholder engagement and participation and 4) integrated programming approach.

Please note that whenever references to projects are made, the name of the principal grantee is used.

Before delving into more in-depth discussions, some general considerations regarding the CCCA phase 2 portfolio are laid out here:

- Thorough planning and its documentation: Despite the small funding volumes per project, the planning phase and the related documents has been approached in a rigorous way.
- Focus on knowledge development: Given the importance of learning for the various small-scale projects, knowledge generation has been prioritized as a core focus of implementation.
- Widespread mainstreaming across most of the relevant sectors: Having in mind that some ministries and sectors have never before integrated climate change considerations in their planning and administrative processes, it is commendable that 14 different line ministries and agencies have been supported to build their own capacity as well as to lay institutional groundwork for future activities and projects.

Adaptation to climate change impacts and the identification of suitable adaptation activities and technologies require a somewhat rigorous assessment of current and future climate risks. Hence, the majority of adaptation-oriented projects of CCCA phase 2 have invested significant resources, time and efforts, even though at different levels, to assess climate risks during the planning or early implementation phase.

How Was Climate Risk Assessed? Has Data and Information about Past, Current and Future Climate Conditions Been Used?

The approaches range from mostly participatory, qualitative and perception-based methods, that were, for instance, applied by the MoE, MoEYS, CRDT, to the rare application of quantitative approaches, and in only two cases the use of future climate projections and scenarios (MRD and PDOE). In other words, scientific data and information on climate impacts, vulnerability and risks has had limited usage in the identification of appropriate adaptation measures.

VILLAGERS DURING A PARTICIPATORY, QUALITATIVE CLIMATE RISK AND VULNERABILITY ASSESSMENT PROCESS, MAFF PROJECT (GERES, 2016)

The reasons were not systematically assessed, but certain statements during interviews indicate that there is little awareness of the added value that scientific climate information could have in view of improving the selection of activities and technologies. In addition, the potential distortion of the analysis by 'incorrect' perceptions was not considered a problem.

Several projects have applied the vulnerability reduction assessment methodology developed by UNDP Cambodia in 2014. Some of the interviewees indicated that they modified some parts of the methodology due to the recognition that the application - for example, long lists of assessment questions – is cumbersome and too time-consuming. Even cases were reported where facilitators filled out the forms themselves instead of capturing the answers by participants. A few interviewees also questioned the usefulness of the assessment results in view of designing activities, while the value was rather seen in a kind of general awareness raising of aspects related to climate risks.

To What Extent Have the Findings of the CRVAs Been Used in the Identification and Selection of Adaptation Measures?

The purpose of the CRVAs conducted was, except of the PDOE project, in all cases related to the identification and selection of appropriate, effective and impactful adaptation measures. All, except of the MoH project, included primary data collection, i.e. surveys, focus group discussions. The best use of secondary data was found in the MoH project that produced an excellent overview of climate impacts and vulnerabilities related to various vector and water-borne diseases, with evidence from studies in Cambodia and beyond. Something to be learnt from for other sectors.

Overall, the relationship between the CRVAs findings and the selection and design of activities/ technologies remains somehow opaque, or at least meagerly documented. The most systematic approach (based on a methodology developed by CCAFS) was pursued in the MAFF project. However, the reasoning behind the selection of certain activities remains unclear even in this case. It may be useful to debate whether most of the proposed and selected activities would turn out to

be different if more rigorous assessments (including the use of quantitative data and information) were conducted. This is due to the fact that the selection is based on (a) proposals for so-called no-regret measures (i.e. measures that pursue also other economic, environmental and social benefits in addition to climate resilience benefits); and (b) the experience and existing capacity levels by communities and/ or planners and implementers. In other words, the question whether it is worth to invest more resources, time and efforts into more rigorous CRVAs appears to be important to be raised.

This should obviously be seen in view of the added value of the findings, and eventually a 'better' selection of activities and measures. In this regard, few warning signs of potentially maladaptive activities were found, such as an irrigated vegetable garden that stayed unused due to extremely hot temperatures (allegedly due to high soil temperatures and evapotranspiration rates etc.) despite of available irrigation water. Critically assessed, that should not happen in an adaptation project that includes a rigorous CRVA as a basis for the selection of activities and technologies.

Recommendations

There is no one-size-fits-all approach to CRVAs. They are location-, actor- and hazard-specific and depend on the availability of resources, time and capacity levels of the involved facilitators, assessors and participants. Hence, it is recommended to design or choose a tailor-made methodology for the specific location, group of stakeholders, purpose etc. USAID and others offer guidelines as to how to design appropriate assessments as opposed to the use of a harmonized and standardized approaches. This could save resources, time and efforts.

It seems that the use of climate information is constrained by a limited accessibility and availability of quantitative data and information at national and sub-national levels. However, the significant advancements in the area of climate impact science during the recent years should be better capitalized on in order to increase the impact of adaptation projects in Cambodia. Even if the data source or provider is regional or global, the information will be useful and usable for the project design at national and sub-national level. Following this line of thought, stakeholders should be confronted with the concept of maladaptation, in order to strengthen the awareness for more rigorous planning methods that have a higher likelihood to avoid the selection of maladaptive measures and activities.

There is a wealth of co-design and co-creation methods as part of adaptation planning that has been tested and experimented with in other countries and contexts, that should be used in the design of upcoming adaptation programmes and projects.

Involving Private Sector Actors

Cambodia has achieved remarkable economic growth and development gains over the past two decades. It is expected to achieve middle-income status in the near future, having averaged economic growth rates over 7%, making it one of the fifteen fastest growing economies in the world. Economic development has been driven by very strong growth in the rice, garment, construction and tourism sectors. The backbone of this growth is fueled by private investment and the ever-increasing landscape of international and Cambodian companies in the beforementioned sectors. However, the role of the

public sector in providing a conducive regulatory framework and policy environment, that set incentives for investments in a low-carbon and climate-resilient transformation, is vital.

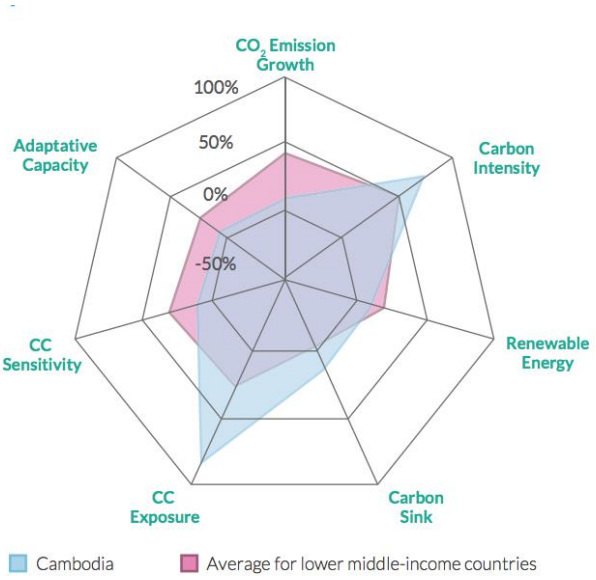

FIGURE 1: CAMBODIA'S CLIMATE-RESILIENT GROWTH IN COMPARISON WITH LOWER-MIDDLE INCOME COUNTRIES (GGGI, 2018)

GGGI (2018) considers climate-resilient and low-carbon aspects of Cambodia's growth particularly challenging as compared to other countries in the lower-middle income countries. It summarizes that Cambodia faces particular challenges with its adaptive capacity, and has a higher level of sensitivity to climate change impacts, alongside a higher growth rate in carbon dioxide emissions and lower uptake of renewable energy (see figure 1).

Nevertheless, the carbon intensity of Cambodia's economy is still lower than its peers, and Cambodia is less exposed to climate change from a biophysical perspective than other countries in this same group.

To improve the investment climate, various incentives are available to foreign investors including 100% foreign ownership of companies, corporate tax holidays of up to eight years, a 20% corporate tax rate after the incentive period ends, duty-free import of capital goods, and no restrictions on capital repatriation. Despite these incentives, investors are still worried about corruption, a limited supply of skilled labor, inadequate infrastructure and a lack of transparency in government approval processes (KAS 2018). All of these aspects of the wider business and investment climate are obviously framing the involvements of the private sector in climate change-related programming.

CCCA phase 2 grants have been involving private sector in a couple of activities, despite the fact that the grants have exclusively been received by either ministries, NGOs or research

In What Ways Were Private Sector Actors Involved in CCCA Phase 2 Grants?

The roles that private sector actors played vary according to the respective climate policy objectives, either mitigation or adaptation.

In projects that predominantly focused on mitigation, energy efficiency or energy saving, they acted as:

- Investors in low-carbon technologies and equipment (e.g. GERES, MME, NBP project);
- Suppliers and sellers of low-carbon technologies and equipment (MME, NBP projects);
- Users of emission-intensive machinery and equipment (e.g. GERES project);
- Recipients of subsidies (e.g. MME project);
- Operators of energy-intensive buildings (MoT project);
- Provider and recipient of advisory services on low-carbon technologies and equipment (e.g. MME, NBP project).

INSTALLATION OF PLASTIC LAGOON AS PART OF A MEDIUM-SCALE BIODIGESTER SYSTEM AT A PIG FARM – NBP PROJECT

In projects that predominantly focused on adaptation, the role of private sector actors was overall narrower. Besides small and medium-size enterprises, there were quasi-private entities, for example community-based committees, that managed and operated, that acted as:

- Operators and managers of small-scale water supply systems (e.g. NCDM, CRDT project);
- Operators and managers of chicken and irrigated farms (e.g. MAFF project);
- Operators of agricultural input shops and provider of advisory services (MAFF project);
- Operators of water-saving buildings (e.g. MoT project);
- Recipient of advisory services on water management (e.g. NCDM project).

It will be important for future CC programming to establish engagement strategies that are tailor-made in view of the respective roles of private sector in the project. The mode of interaction between the project and the private sector actor was in most cases non-monetary but focused on knowledge inputs (e.g. training) and coordination (e.g. organization of workshops and consultation fora) provided by the respective public sector actor. Overall, there seems to be limited capacities and competencies among public sectors stakeholders to involve private sector differently than in aforementioned ways.

What Are the Incentives for the Private Sector to Invest in Low-Carbon Climate-Resilient Technologies and Practices? And What is the Role of the Public Sector in This?

As demonstrated in table 1, the public sector has many fiscal and regulatory instruments at hand to incentivize or disincentivize certain technologies and practices used by the private sector. There are some examples in the CCCA phase 2 grant facility that have tested subsidies as financial incentives. For instance, the MIH project provided subsidies to entrepreneurs who invested in low-carbon technologies. While this policy instrument has been used in many other countries to incentivize the use of and investment in low-carbon technologies, it appears that in this very case the number of companies that received subsidies (20 to 25 % of the investment) is still very limited and the MIH struggled to identify entrepreneurs who are interested to invest in low-carbon technologies.

GERES' TEAM PROVIDING ADVICE ON RICE-HUSK BRIQUETTES AT JOYWIN GARMENT FACTORY, PHNOM PENH – GERES PROJECT.

In another case, the key input to a transition to a low carbon energy source in the garment sector, in this case rice husk briquettes (GERES project), have been R&D activities and the facilitation towards building a new value chain. The current situation can be described as a 'stalemate' between buyers and sellers/ producers. The potential buyer (e.g. garment factories) hesitates to place orders due to limitations on the supply side to deliver the required quantities, while the supplier waits for significant orders to further expand production of RH briquettes. One of the lessons is that it requires an intermediary to facilitate between actors during this transition phase. In this very case, this role has been assumed by an NGO, but there are indications that service providers could emerge that take on this role incentivized by

new business opportunities; mostly fuelled by the chance to financially benefit from energy cost savings in the garment sector.

<table>
<tr><th colspan="4">Incentives: 'Carrots'</th></tr>
<tr><td colspan="2">Financial incentives
• tax credits
• subsidies
• grants, other direct funding
• loan guarantees
• procurement policies
• feed-in tariffs</td><td colspan="2">Non-financial incentives
• publicly-funded RD&D
• infrastructure investments
• education/information/labeling
• technical assistance
• award/recognition programs
• grid access</td></tr>
<tr><td>Advantages
• Potentially useful to advance 'cutting-edge' technologies.
• Often politically popular.
• Can be targeted to overcome particular market obstacles or promote specific technologies.</td><td>Disadvantages
• Require government to spend money.
• Spending may be politically influenced and not always cost-effective (e.g., subsidies continue even when no longer needed).
• Results are difficult to predict. They tend to be biased toward well-understood options.</td><td>Advantages
• Provide means to address other market failures/ barriers.
• Usually politically popular.
• May have a variety of spillover benefits.
• Can help address competitiveness concerns.</td><td>Disadvantages
• Difficult to target RD&D, infrastructure investments.
• Institutional and technical capacity required to develop and deliver programs.
• Benefits/impacts may be limited, especially without complementary financial incentives.</td></tr>
<tr><th colspan="4">Disincentives: 'Sticks'</th></tr>
<tr><td colspan="2">Market-based policies
• energy or emissions taxes
• emissions cap-and-trade programs</td><td colspan="2">Prescriptive regulations
• emissions standards
• efficiency standards
• portfolio standards</td></tr>
<tr><td>Advantages
• Can be applied economy-wide.
• Markets deliver least costly reductions.
• Individual firms, consumers retain choice, flexibility.
• Generate revenues that can be used for other purposes.
• Consistent price signals yield economically rational outcomes across all covered sectors.
• Can be designed to meet specific objectives in terms of cost, emissions reductions, etc.</td><td>Disadvantages
• May generate strong political opposition because they raise prices.
• Energy-price impacts on poor households will be a concern (though should note that revenues generated by policy can be used to address this issue).
• May raise concerns about impacts on domestic industry in terms of jobs and competitiveness in world markets.
• Price signals may be inadequate to overcome other market failures or stimulate new technologies.</td><td>Advantages
• Effective where price signals alone would not elicit all cost-effective responses (e.g., car, building, appliance markets).
• Policy outcomes are relatively certain (though costs may not be).
• Many manufacturers, industries already subject to some regulation.
• Costs are less evident, potentially reducing political opposition.
• No action needed on part of consumer.</td><td>Disadvantages
• Usually do not encourage or reward better than minimal compliance.
• Require technical and institutional capacity to develop, enforce standards.
• Different policies needed for different sectors.
• Defining cost-effectiveness is uncertain and often contentious, especially if regulators have to project future tech development.
• Less flexible and (potentially) more costly than market-based approaches.
• Policies need to be updated over time.</td></tr>
</table>

TABLE 1: POLICY OPTIONS FOR PROMOTING A TRANSITION TO A LOW-CARBON ENERGY SYSTEM (IAC REPORT, 2007)

This means that industries transfer all risk of the transition to a new energy technology (e.g. related to the risk of failure of technology modifications of the boilers and other supply chain risks) in exchange of the financial gains made through reduced energy costs. Another important lesson is that international buyers, such as H&M, can exert their market power by introducing requirements related to climate and environmental standards and thereby, accelerate transitions and investments to low-carbon technologies that may otherwise take much longer, in the absence of any external pressure. Similar pressures could be exerted by other fiscal or regulatory policy changes.

New business opportunities appear also as a result of lessons learnt in the management and the operation of small-scale off-grid energy solutions. The MME project, for example, has established community-based committees to manage and operate the small-scale energy systems that were installed. However, it is recognized that these services could probably better be provided by service companies (e.g. ESCOs, energy service companies; see also KAS 2018). Like for any other

relevant sector in rural and remote areas, high transaction and transport costs etc. still limit the number of service companies operating in these areas. The development and strengthening of these service providers need to be further promoted and supported by state actors in the future.

Another promising approach to incentivize entrepreneurs and investors in the tourism sector has been applied in the MOT project, that promotes the Green Hotel Standards as an example of an award or recognition program. Again, this example is a good start but has not yet reached significant coverage. Furthermore, the establishment of a certification schemes or the inspection of these schemes offer new business opportunities for inspecting service providers. As observed in many countries, economic activities are increasingly "codified" and adherence to codes is increasingly controlled through third-party certification. This has led to the growth of audit, testing and certification companies, which now form a profit-making sector in their own right. The appropriate relationship between standard-setting and accreditation bodies (often performed by the public sector or NGOs), certification and inspection service providers[1] should be carefully considered and tested in Cambodia before scaling-up.

Recommendations

While Phase 2 has used grant-making as the principal support modality, it may be worthwhile to consider alternative financing arrangements (matched funding, competitive grants, loan guarantees, etc.) as well as institutional arrangements (e.g. public private partnerships) in order to more profoundly involve private sector actors. For mitigation projects and policies, the Climate Finance Lab, for instance, offers new and innovative examples and solutions to leverage significant private investments.

In line with this, it is also recommended to involve the insurance and finance industry more systematically in CC programming, particularly given their relevance and expertise in view of risk transfer mechanisms. Climate risk insurances can play numerous roles in providing security against the loss of assets, livelihoods and even lives in the post-disaster period; ensuring reliable and dignified post-disaster relief; setting incentives for prevention; providing certainty for weather-affected public and private investments and easing disaster-related poverty, and spurring economic development (GIZ, 2016).

Also access to other financial services (e.g. microcredit, saving) have received significant attention in many other countries as effective ways of managing climate risks. And should therefore be integrated in CC programming.

Furthermore, it is recommended to engage private sector actors in energy-intensive and high-emission sectors more comprehensively in future CC programming. Firstly, this regards an expansion of actors in sectors that have already been covered in phase 2 (such as agriculture, tourism, garment), and secondly, an extension towards involving sectors that have not been addressed yet, but are relevant in view of Cambodia's emission profile, like the construction and forestry industries.

As there is relatively little involvement of private sector actors in adaptation projects, the risks associated with extreme weather events should be further promoted among this group. The negative impacts of climate change create and exacerbate risks to financial investments for adaptation by causing 1) direct physical impacts on the investments themselves, 2) degradation of critical supporting infrastructure, 3) changes in the availability of key resources, 4) changes to workforce availability or capacity, 5) changes in the customer base, 6) supply chain disruptions, 7) legal liability,

[1] See, for instance, chapter 8 of FAO 2003

8) shifts in the regulatory environment, 9) reductions in credit ratings, and 10) additional impacts that alter competitiveness (e.g., shifts in consumer preferences) (AMETSOC, 2010).

Creating Sustainable Change

In order to discuss the sustainability of achievements made by grant-financed CCCA phase 2 projects, developments of the underlying policy and institutional frameworks would need to be assessed. However, this is beyond the scope of this report. But before the light is shed on aspects of sustainable adoption of low-carbon climate-resilient technologies and practices, the opportunities and limitations of small-scale pilot projects towards sustainable transformation are discussed.

Opportunities and Challenges of Pilot Projects - To What Extent Do CCCA Projects Fulfill Good Practice Criteria for Pilot Projects?

Each of the 22 projects under review have received between 125.000 USD and 450.000 USD over implementation periods of 2 to 3 years. That clearly categorizes them as pilot projects, also called feasibility studies or experimental trials. Small-scale, short-term experiments usually help to learn how a large-scale project might work in practice. They are often used to try out different approaches, develop evidence-based strategies, identify good practices, and provide policy guidance for the benefit of possible future initiatives.

Ideally, good pilot projects provide a platform to test, prove value and reveal deficiencies before spending a significant amount of time, energy or money on a large-scale project. Pilot projects are particularly valuable in situations where little is known about the specific activity or topic, or when executing unprecedented approaches. It is particularly relevant for pilot projects to use robust and clear metrics for how success will be determined.

CCCA projects have not been exclusively planned as pilot projects, however, it may be worth to examine whether some key ingredients that make up for a successful pilot are reflected in the design and implementation of the projects.

Vreugdenhil et al. (2012) specify regular characteristics of pilot projects and highlight knowledge development and subsequent learning as the fundamental core issue. GIZ further identifies pilot projects as an important element of a successful strategy to scaling-up positive impact.

In view of these characteristics, the CCCA phase 2 project portfolio features a couple of promising signs. It is noteworthy that each proposal has a substantial chapter on knowledge development, sustainability and scalability. Their scope and quality vary but it is commendable to request proposing agencies to pay attention to these aspects from the very start of project conceptualization.

A MICRO-GRID SOLAR-BASED ELECTRIFICATION SCHEME MANAGED BY A COMMUNITY-BASED COMMITTEE IN PURSAT PROVINCE – MME PROJECT

However, in order to reap the full benefits from pilot projects, it is essential to collect relevant data and information during the implementation phase, i.e. establish and invest in rigorous monitoring and evaluation systems. This objective is in most cases not achieved and should be rectified in future cases.

Some of the approaches should be further examined in view of their targeting strategy. For example, the financial sustainability of a fee-based operation and maintenance approach is strongly affected by the purchasing power of beneficiaries, i.e. the ability to pay for fees. Some of the communities targeted were selected for their remoteness and high levels of poverty, and therefore level of fees or charges were set as low as possible. This creates a conflict between the goal of replicability and sustainability on the one hand and poverty reduction on the other hand. Approaches to target strata of society and communities that can better maintain operations and maintenance of introduced technologies should be considered in order to overcome this issue.

What Are the Determining Factors for Sustainable Adoption of New Technologies and Practices? Have CCCA Phase 2 Projects Considered Those During Planning and Implementation?

A certain number of CCCA phase 2 projects have focused on the testing and promotion of new or alternative technologies and practices (e.g. MAFF, NCDM, MME, MIH, GERES, NBP, CRDT).

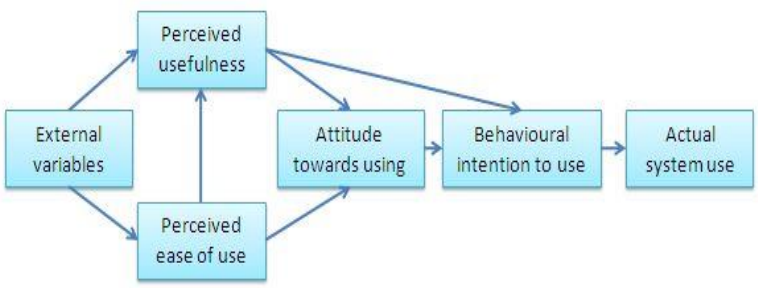

FIGURE 2 : TECHNOLOGY ACCEPTANCE MODEL (SOURCE : DAVIS ET AL., 1989)

Before discussing the lessons learnt of these undertakings, it will be worthwhile to briefly discuss success factors. A wide range of scientific literature on technology adoption have provided important guidance to better understand and design the introduction of new technology or practice. Firstly, the technology acceptance model by Davis et al. (1989) as the most widely applied model that describes how users come to accept and use a technology. The model suggests that when users are presented with a new technology, a number of factors influence their decision about how and when they will use it (see figure 2). Secondly, Suebsin and Gerdsri (2009) have presented key factors driving the success of technology adoption (see box 1).

In the following paragraphs, these key factors will be discussed in view of the approaches used in the CCCA phase 2 projects:

Functional performance:

This dimension has been the key focus of the respective projects. Different technology designs and options have been compared and users have been well consulted in the planning phase (e.g. CRDT, NCDM).

BOX 1: KEY DIMENSIONS OF TECHNOLOGY ADOPTION (AFTER SUEBSIN AND GERDSRI, 2009):

- **Functional performance is the characteristic of how the technology will perform;**
- **Acquisition cost is the cost of technology that adopters have to pay in order to possess the product;**
- **Ease-of-use is referred to as how easy to users in order to use the technology;**
- **Operating cost is the cost that occurs when a user utilize the technology;**
- **Reliability relates to how free the technology is from mal-functionality, including the useful lifetime of it;**
- **Serviceability refers to how long it takes and how expensive it is to repair the technology if it goes wrong;**
- **Compatibility is the way that the new technology fits with other existing devices or business requirements.**

Acquisition cost:

Acquisition or installation costs have in most cases been fully covered by the grant while manual labor was contributed in-kind by communities in several cases (e.g. NCDM, CRDT). For the small-scale solar energy and water systems at community level, the user fee systems were not designed to redeem the acquisition costs but to cover the operation and maintenance (O&M) costs. In some cases (CRDT, NCDM, MAFF), even the repair costs are unlikely to be covered by the accumulated savings. In many cases, the fees needed to be increased by several hundred percentages if repayment was the goal. In the case of the MIH project, subsidies (of 20 to 25% of the total acquisition cost) were paid for by the grant.

Ease-of-use:

Since users, managers and operators have been involved throughout the process, the user-friendliness has always been secured. Some limitations are related to the maintenance of solar PV systems or water pumping and filtering technology, when this role was assumed by community members that were trained by the implementing agency or a service provider.

Operating cost:

Operating costs can be divided into staff costs, material input costs and energy/ electricity costs. Staff costs are very low since the management committee members receive a quite low remuneration. Material input costs, where applicable (e.g. for the chicken pellet production), and electricity costs are directly incorporated in the price. The level of fees or sales prices charged for services and products (such as power access, battery charging, safe water bottles or chicken pellet production) are mostly below market rates, which is due to the agreements between O&M structures (i.e. committees) and buyers and (i.e. villagers). Also, having in mind that there is grant money covering for costs, if necessary.

Reliability:

The lifetimes of the solar energy and water systems, as well as other processing technologies promoted are considerable (i.e. ranging from 5 to 20 years). Consequently, there is generally no major breakdowns to be expected for many years to come. However, some systems are more technically demanding and prone to technical failure. In such cases, it depends on the technical savviness and education of the responsible committee member in charge. There have been signs that it may be worthwhile to rather rely on external service providers (see also chapter 3), also due to limited skills sets and learning capacities of committee members.

Serviceability:

With regard to the availability of certain low-carbon equipment, machinery and spare parts, it was found that in the majority of cases they needed to be imported. This constitutes an additional barrier for potential adopters and investors.

Compatibility: Does not apply in the observed cases.

Most of the approaches to test feasibility of specific technological solutions (e.g. of low-carbon technologies such as the use of rice husk briquettes (GERES project) or solar PV system in remote areas (MME project)) were focused on technological characteristics. Financial sustainability calculations have been treated as second priority with less rigor.

Have Additional Factors that Determine Technology Adoption and Likelihood for Scaling-Up been Considered?

Behavioral and attitudinal change, as highlighted in Davis' technology acceptance model, is a key success factor for the adoption of agroecological approaches in agriculture. Agroecology is less input intensive but more reliant on knowledge about certain cropping patterns, timing of sowing and planting, planting techniques etc. The key to scaling-up appears therefore to be the level of coverage and the quality of agricultural advice and extension services. Approaches, like the agro-clinic model tested in the MAFF project, appears to be problematic due to several reasons. The ability to provide on-field advisory services was limited in a number of cases, as mostly shopkeepers were selected. And where advisory services are linked to agro-input sales, there are risks that the advice promotes an agricultural model closely linked to the respective inputs (herbicides, pesticides, machinery, fertilizer) but potentially neglects other alternatives (like biological pest management, soil and water conservation techniques or land husbandry that are focused on soil organic matter enrichment). In addition, learning models matter. Exchange visits, peer-to-peer knowledge sharing events, model farms (e.g. in CRDT project). Particularly for target groups that are used to experience-based learning such learning models work better than classroom-style training.

Ownership: It is widely recognized that ownership and related leadership by local actors are key to the acceptance and adoption of new concepts or models, as well as for their sustained impact (GIZ, 2010). The institutional set-up of projects needs to involve local stakeholders and leaders from the start. The review has shown that CCCA phase 2 have mostly employed effective mechanisms to ensure high levels of ownership and local leadership, including community-run management of operations and maintenance of introduced equipment or technologies.

Recommendations

Overall, the outcomes of the reviewed pilot projects have indicated that:

(1) there are 'natural' limitations of what pilot projects can achieve and that they need to be well embedded into supplementary action and policy framework setting at other implementation levels;

(2) the technological feasibility has been well tested and exemplified in most cases;

(3) the testing of economic feasibility needs more rigorous approaches;

(4) the planning of sustainability requires 'big picture' thinking from the start of the design phase, which could potentially benefit from a more rigorous option appraisal;

(5) the advances in climate impact and adaptation science should be more consistently used and integrated in the planning of suitable and effective adaptation measures;

(6) the investments in climate risk and vulnerability assessments require a careful consideration of resource use, capacities, methodology and expected outcomes.

Annex 1: List of CCCA phase 2 Grant-Financed Projects

Grantee		Project Title
MoH	Ministry of Health	Strengthening country capacity to deal effectively with climate-sensitive vector-borne and water-related diseases and reducing the health impacts of disasters
MPWT	Ministry of Public Works and Transport, Department of Planning (DoP)	Green House Gas Emissions Inventory and Mitigation Plan for the Road Transport Sector
MoWRAM	Ministry of Water Resources and Meteorology	Increase the Knowledge of the water cycle in order to reduce vulnerability to Climate Change hazards through an integrated approach (IKWCRCC) in 3 districts of Oddar Meanchey province
MRD	Ministry of Rural Development	Climate-Proof Integrated Rural Community Development in Kampong Thom Province
NCDM	National Committee for Disaster Management	Living with Disaster Risk Reduction and Climate Change Impact in Coastal Areas
MOWA	Ministry of Women's Affairs	Mainstreaming of gender impacts of climate change and disasters in education sector
MOEYS	Ministry of Education, Youth and Sports (MoEYS), Department of Curriculum Development (DCD)	Mainstreaming Climate Change in Education (MCCE)
MAFF	Ministry of Agriculture, Forestry and Fisheries	Increasing Resilience to Climate Change for farmers in rural Cambodia: through Climate Smart Agriculture practices
MIH	Ministry of Industry and Handicraft	Demonstration of best practices on available technology for contribution to climate change adaptation and mitigation in industrial and handicraft sectors
MME	Ministry of Mines and Energy	Promote Low-Carbon Technologies in Energy Sector
MOT	Minstry of Tourism	Public Awareness of Climate Change in Tourism Sector
MLMUPC	Ministry of Land Management, Urban Planning and Construction	Promote settlement development adapted to natural disasters
MOINFO	Ministry of Information	Strengthening and Capacity Building on Climate Change through Television, Radio, and Digital Media
MOE	Ministry of Environment	Develop and test low carbon resilient approaches and options in urban areas
GERES	Group for the Environment, Renewable Energy and Solidarity	Fuelling the low carbon development of Cambodian manufacturing industries by valorizing agro-industries' biomass residues into energy
NBP	National Biodigester Program	Medium Scale Biodigester Innovation for Smart Environment (MBI-SE)
CRDT	Cambodian Rural Development Team (CRDT)	Promoting resilience in agricultural production and enterprises for food security among subsistence farmers along the Mekong
MAFF	General Department of Agriculture (MAFF)	Ecological Intensification and Soil Ecosystem Functioning (EISOFUN)
WCS	Wildlife Conservation Society	Participatory Land Cover Monitoring of Cambodian Landscapes
MoH	Ministry of Health	Vulnerability & Impact Research Targeting Usability and Effectiveness (VIRTUE)
NEXUS	Nexus for Development	Solid Waste Management Strategy
PDOE	Provincial Department of Environment in Stung Treng	Vulnerability Assessment of Local People Living in and near Ramsar Site to Climate Variability and Change

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