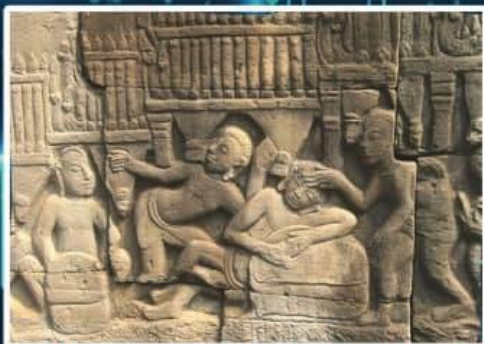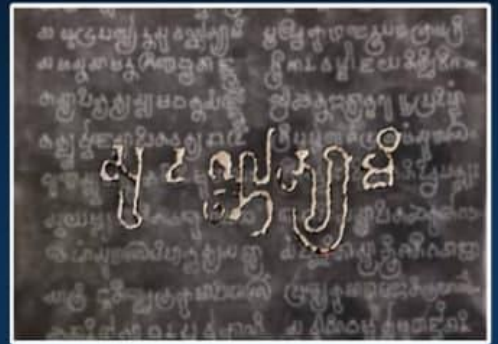*Insight*

Cambodia Journal of Basic and Applied Research

Insight

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News
Student Research:
"Innovative research on shampoo and dishwashing detergent made from Kapok leaves"

A team of six students was recently awarded first place in the *"Our Business"* competition by His Excellency Dr Hang Chuon Naron, the Minister for Education, Youth and Sport, which included a prize of 1,000 USD plus a gold medal and certificate for each member. The team comprised four senior female students: KEM Tha, KAN Superjaria, KHENG Lada, and KHEUN Chenda from the Department of Bio-Engineering at the Royal University of Phnom Penh (RUPP); as well as two other senior female students: JHON Kaly from the National University of Management (majoring in Accounting), and RETH Panha from Institute of Foreign Language at the RUPP (majoring in Thai literature), both with a scholarship from the Harpswell Foundation. Eighteen teams entered, which was narrowed down to fifteen in the first round of the competition. Of the five finalists, only three teams were selected.

The team designed a factory for producing dishwashing detergent from kapok leaves. They decided to enter the *"Our Business"* because they believed their product was innovative, environmentally friendly, and had the potential to obtain a large market share both in Cambodia and overseas. Each team member invested 100 USD of their own funds in the project, using techniques learned at the Department of BioEngineering. The experiment was conducted solely by the six students. While the four students from the Department of BioEngineering worked on the production of the detergent; the two other students worked on budgeting, planning and market research.

The team demonstrated their commitment to each other by writing a proposal to enter the competition. From the outset, win or lose, they were determined to take advantage of the high demand for dishwashing detergent and successfully realise their dream of running their own business.

The project is innovative in its use of kapok leaves as an active ingredient in dishwashing detergent to improve its function as a detergent, while also being gentle on the skin of users. Their target market includes street food vendors, restaurants, and retailers in both rural and urban markets. The team were surprised that they were awarded first place, as it was the first time they had entered a competition of this nature. To enable to team to continue with their innovative research, His Excellency Dr Chet Chealy, the Rector of RUPP granted 1867.5 USD to the four students from the Department of BioEngineering. This grant will be managed by lecturers Dr TIENG Siteng and Dr LONG Solida to investigate how the properties of dishwashing detergents made from Kapok leaves may be improved, as well as how shampoo and liquid body soap products may be formulated.

The four students will work with the grant managers to further develop the concept and introduce these products to the market. The development team will run four simultaneous activities including product improvement, assessing the physical and chemical properties of kapok leaves, the development of a liquid body soap product, and the development of a shampoo product. These activities are expected to be completed by August 2021. The research will be published by the Department of Bioengineering in *Insight: Cambodia Journal of Basic and Applied Research*.

Faculty Research:
"The Approval of Higher Education Improvement Project (HEIP) Research Project Round II"

The 90.0 million USD Higher Education Improvement Project (HEIP) funded by IDA Credit, including a 2.5 million USD contribution from the Royal Government of Cambodia is being implemented over 6 years between July 2018 and June 2024. The objective is to improve the quality and relevance of higher education and research in the STEM and agricultural fields at target Higher Education Institutions (HEIs) in Cambodia, as well as to improve governance of the sector as a whole. As part of Component 2 of the project, *"Improving Research in STEM and Agriculture"*, the Royal University of Phnom Penh has been granted 14 projects with a total amount of 3.3 million USD to assist local academics to conduct and publish research in international peer-reviewed journals.

These publication are part of realizing the vision of RUPP to become Cambodia's leading university in applied and academic research, as stated in the Policy on Research Development and Innovation. Research proposals must fall into one of three windows: (i) research for industry; (ii) research for policy-making; or (iii) frontier research. In early 2021, six research projects across different disciplines, with a total budget of 2,455,810.31 USD on top of the eight research projects approved in early 2020.

Research Project 1

Research Topic: Synthesis, characterization, device fabrication, and the application of nanomaterials and 2-Dimensional materials

Duration of the Sub-project: 3 years

Total Cost of the Sub-project: 1,050,365.75 USD

Research Team: Dr SRIV Tharith (Principal investigator), Dr SOUM Veasna, Dr PECH Ouksaphea, Dr KHUN Kimleang, Dr CHEY Chan Oeurn, Dr SOU Kalyan, Mr YANN Rem, Miss. CHUONG Mary, Dr KHAN Sovann, Prof. Dr CHEON Hyeonsik, and Prof. Dr SHIN Kwanwoo

Nano- and 2D materials have attracted interest among the scientific community because of the suitability of their properties for technological applications in health care, thin-film solar cells, analytical sensors, and optoelectronics. An enhanced understanding of the properties of these materials is expected to also lead to other useful applications. In this project, nanomaterials will be synthesized using hydrothermal methods and thermal treatment to investigate the properties of AgNP, CNT, and ZnO nanoparticles, transition metal oxides (ZO_x) (Z = Mn, Fe, Ni, Mo, etc.), electrode materials, as well as 2D materials such as tin chalcogenides, transition metal di-chalcogenides and alloys (MoS_2, WSSe, MoSSe), and As_2Te_3, including phosphorous-arsenic alloy (P-As).

The methods used to analyze the nano- and 2D-materials include X-ray diffraction for structural analysis; UV-visible spectroscopy for bandgap analysis; AutoLab for electrochemical analysis, energy-dispersive x-ray spectroscopy (EDS/EDX) for chemical microanalysis; x-ray photoelectron spectroscopy (XPS) for elemental composition analysis; scanning electron microscopy (SEM) for micro-surface topology; atomic force microscopy (AFM) for micro and nanostructural analysis and determining the thickness

of the 2D materials, as well as Raman and photoluminescence (PL) spectroscopy. The UV-visible spectra, XRD patterns, Raman, PL and electrochemical analyses will be conducted locally using the existing facilities of the Laboratory of Applied Nanotechnology (LAN), and the some to-be-established Advanced Spectroscopy and Electronic Printing Technology Lab. The remaining experiments will be performed in the laboratories of foreign collaborators in Korea, Japan and Thailand.

OriginPro and CrystalMaker software will be used to support advanced scientific analyses to draw crystal structures for publication. The second part of the research will focus on printing techniques using well-understood materials to improve the fabrication of solar cells and analytical sensors. Specifically, the fabrication of glucose and iodide detection sensors and two corresponding sample sensor products will be registered and developed. The synthesis, characterization, and prototyping of these devices as part of this research are likely to result in higher quality, better performing and lower-cost devices that may contribute to the development of local industries similar to Thaung Enterprises. Scaling up production will be considered to improve the sustainability of the project.

Research Project 2

Research Topic: Analyzing bioactive compounds of marine algae to develop moisturizing, hyperpigmentation and anti-aging cosmeceutical creams or lotions

Duration of the Sub-project: 3 years

Total Cost of the Sub-project: 395,292.00 USD

Research Team: Dr LON Solida (Principal investigator), Dr HUY Hangsak, Dr CHENG Khley, Dr TIENG Siteng, Ms UNG Sivlin, and Associate Professor SOUSA Emilia

Specific objectives: To extract and characterize the bioactive compounds of brown, red and green algae to formulate cream products with the potential to be commercialized in Cambodia.

Hypothesis: Selected algae possess several saccharides and phenolic compounds that have anti-stress oxidation and photo-protective properties. Known compounds of interest may be enhanced by new molecular structures. Two types of emulsions will be formulated possessing a wide range of antioxidant, anti-melanogenesis, and moisturizing effects using *in vitro* and *in vivo* tests, which may be patented.

Methodology: Solvents with different polarities will be used to extract and further purify the compounds. Structure elucidation will use nuclear magnetic resonance (NMR) spectroscopy and high-performance liquid chromatography (HPLC). Antioxidant properties will be assessed using DPPH, metal, hydroxy radicals, and reducing power assays. UVA-UVB protection, anti-aging, anti-melanogenesis properties will be tested using HaCat and high expressing melanin cell lines. Cells viabilities will be examined using an MTT assay. Type-1 pro-collagen and melanin contents, and an expression of MMP-1 will be evaluated and confirmed using a western blot assay. Tyrosinase, elastase assays will also be included. Several types of day creams will be formulated by adding to the base formula of the algae extracts and/or isolated compounds. The most active compound will be selected for

development. Cream characteristics such as the rheology, chemical and physical stability, oxidation stability, and phase separation stability, pH, colour, smoothness, spreadability, and conductivity will be also determined. Volunteers will be selected to test the final products for 60 days. Skin characteristics such as epidermal water loss, capacitance, firmness, sebum, and wrinkles will be evaluated using a skin testing machine. Statistical analysis will be performed using ANOVA analysis.

Expected results: We expect that the extraction and purification process will render a significant number of bioactive compounds -carbohydrates and phenolic compounds with significant anti-aging, anti-pigmentation, antioxidant, and anti-UV radiation properties with potential applications in skincare products. We expect that the creams/lotions will demonstrate excellent potential as patentable and commercially viable products that may support new alga farming and related cosmetic industries in Cambodia. Three master's theses and six undergraduate theses are expected to be realized as part of the project. This will act as a basis for a research group focused on cosmeceutical products to become established within RUPP and Cambodia more broadly.

Research Project 3

Research Topic: Development of probiotic fermented vegetables in Cambodia and their effects on the immune system *in vitro*

Duration of the Sub-project: 3 years

Total Cost of the Sub-project: US$ 232,920.00

Research Team: Mrs HUOY Laingshun (Principal investigator), Ms UNG Sivlin, Dr HUY Hangsak, Dr TIENG Siteng, Associated Professor BOQVIST Sofia, and Asst. Prof. Dr KONSUE Nattaya

Lactic Acid Bacteria (LAB) are among the most advantageous microorganisms in fermented food because of their ability to enhance taste and texture (Bintsis, 2018). Moreover, LAB has been found to have potential antimicrobial (Turner et al., 2017), preservation, and immune system improvement properties both *in vitro* (Jeong et al., 2015) and *in vivo* studies (Karamese et al., 2016). This research project has four specific objectives related to the identification and characterization of LAB, followed by an investigation of optimal culture growth conditions. After obtaining the LAB samples, several compounds will be tested for their inhibitory and stimulating effects. Standard formula optimized for shelf life and quality control will be developed in collaboration with a private sector partner. In our research, we hypothesize that:

- Local fermented vegetable contains many useful LAB strains that have the potential to be used for future commercial food processing ventures.

- Isolating LAB strains may result in antimicrobial compounds, such as bacitracin and hydrogen peroxide that can be used to stimulate RAW 264.7 cell lines to produce TNF-α, IL-10, and nitrogen oxide (NO).

- Traditional fermented formula may be applied to a study of LABs in fermented food, whereby they may be optimized for shelf life and the improved quality of commercial fermented food products.

Methodology:

- The isolation and characterization of different LAB strains from various fermented vegetables will be conducted using the culture method on Man, Rogosa and Sharp (MRS) and M17 agar, before confirmation using the gram stain method and a biochemical test kit (API 50 CHL).

- An agar diffusion bioassay will be used for screening the bacteriocin production and *Lactobacillus sakei* and *Listeria innocua* will be used as indicator organisms. Then the production of H_2O_2 from the LAB will be determined using colourimetric methods.

- Total isolated LAB strains will be screened for activation of the macrophage cell line for TNF-α, IL-10, and nitrogen oxide (NO) production by the ELISA technique and Griess reactions; respectively. In brief, macrophage RAW 264.7, one of the model cell line for the study of the immune system *in vitro*, will be cultured and stimulated by the LAB characterized in Step 1 to determine whether lipoteichoic acid (LTA), an immune stimulatory protein found on the cell wall LAB, may induce the production of TNF-α, IL-10, and nitrogen oxide (NO). To determine the presence of TNF-α and IL-10, supernatant from the culture will be collected and tested using the specific antibodies for these two substances using an ELISA reader. To determine the amount of NO production, the supernatant of the stimulation culture will be tested by using a Griess reagent kit. The absorbance of the mixture will be measured at 540 nm on an automated EL800 plate reader

- LAB with antimicrobial and immunological stimulation criteria will be tested for optimum growth conditions for pH, salt bile, and temperature to clarify which LABs may be suitable for scaled-up production. The isolated LAB will be inoculated on a medium culture with a pH range of 1.5, 2.0, 2.5, 3.0, 3.5 and 4.0, for the determination of the pH tolerance. Similarly, 0.1% - 0.5% bile salts (w/v) will be supplemented with MRS broth to test optimal bile salt concentrations. The strains will be incubated at temperatures of 20, 37 and 44 °C to investigate the function of LAB when progression through the digestive tract of humans.

- A standard formula for industrial production will be developed based on consumer preferences. Two target groups comprising 30 individuals who like fermented foods and another 30 individuals who do not like fermented foods will be recruited to participate in a sensory test of the products developed in the study to determine consumer acceptance. Microbial tests will also be conducted to determine product safety including culturable microorganisms at 22 ^{0}C and 37^{0}C; total coliforms, Escherichia coli; intestinal enterococci; spore of sulphite reducing anaerobes. Tests for physiochemical properties such as turbidity, pH, chlorides, ammonia, nitrites, nitrates, hardness, and iron will be conducted to determine the shelf life and quality of the final products, before launch. SPSS software will be used for the analysis.

Expected outcomes: It is expected that LAB strains from local vegetables and fermented foods will be isolated and characterized to identify those with the potential to be used as a starter for commercially produced traditional

Cambodian fermented foods. Moreover, it is anticipated that an acceptable formula will be established to transform the production of tradition fermented vegetables from the household scale to properly packaged items that meet food safety standards. This research will also serve as an opportunity for emerging researchers to develop collaborative work with the private sector to develop both local and export markets for these products. The work will be published in a peer-reviewed journal.

Research Project 4

Research Topic: Improvement of watermelon varieties through conventional breeding and tissue culture

Duration of the Sub-project: 2 years and 9 months

Total Cost of the Sub-project: US$ 327,037.00

Research Team: Ms Sivlin UNG (Principal investigator), Dr Phanna PHAT, Dr Siteng TIENG, Dr Solida LONG, and Professor Ho-Jong JU

Specific objective: To collect and characterize Indigenous and introduced varieties of watermelon for the selection of incorporation of traits into breeding programs for the development and production of potentially commercialized seeds of new diploid and tetraploid varieties.

Hypothesis: The quality and yield of introduced watermelon varieties and the adaptability of wild/indigenous varieties will be assessed for new varietal development. Five new open-pollinated varieties with traits of interests such as excellent flesh and rind colour, long shelf life, high soluble solids and high yield will be selectively bred using ten lines of tetraploids produced on plant

tissue culture with and without application of colchicine, a chemical agent-induced chromosome doubling.

Methodology: The seed will be collected from eleven provinces including Kandal, Kampong Cham, Kratie, Stoeng Treng, Mondulkiri, Ratanakiri, Preah Vihear, Kampong Thom, Siem Reap, Battambang, and Banteay Meanchey for bot Indigenous and introduced watermelon varieties. Each will be examined for the distinctness, uniformity and stability, and production of harmonized variety descriptions according to UPOV guidelines. Varieties with potential agronomic traits such as, high yield, long shelf life, high soluble solids with yellow, orange, or red flesh colour, that are adaptable to the Cambodian climate will be used in pedigree selection breeding. Two parents will be crossed to produce an F1 which will later be repeated using a self-pollinating or sib mate for the selection of the best line from generation to generation using advanced inbreeding. The best lines (F6/F7) will be tested for potential release as new open-pollinated varieties or new parents for hybrids. Measurement of fruit yield and quality will include fruit weight, length, and diameter, hollow heart, rind pattern, flesh colour and soluble solids.

Uniform and homogenous varieties with high yield and quality according to a first screening, and F4-F6 varieties derived from pedigree breeding will be germinated in vitro for excising of cotyledon for culturing on MS medium supplemented with 1mg/l BAP and 0.1mg/l IAA. These samples will be used to initiate adventitious calli, treated without and with aqueous colchicine at different levels (0, 0.1%, 0.2%, and 0.5%) to induce somaclonal variants showing superior or tetraploid traits. Morphological characteristics and the

number of chloroplasts in each stoma will be used as indicators for discrimination between diploids and tetraploids. Diploid somaclonal variants, F5 and F6 generation derived from pedigree breeding which becomes uniform and homogeneous and show superior traits will be further evaluated in trials. Successful samples may be registered as a New National Variety Release by the MAFF.

Field demonstrations will be conducted with forest communities to introduce and facilitate the evaluation of newly developed open-pollinated seeds based on consumer preferences. Knowledge will be transferred to forest communities on watermelon cultivating techniques utilizing these seeds. Tetraploids will be proposed for producing triploid hybrids for the production of seedless watermelon. Statistical analysis will be performed using ANOVA.

Expected results: It is expected that at least five open-pollinated seed varieties with high yield, long shelf life, high soluble solids with yellow, orange, or red flesh colour and adaptable to Cambodian climate will be produced. These will have potentially for registration as a National New Variety Release, which may be shared with forest communities and industrial partners for commercial production. Further, the industrial partner will be used to act as a seed distributor. Tetraploids and diploids from this project will be used to produce diploid and triploid hybrids of premium quality with an industrial partner to develop and issue patents for commercialization. Three graduate theses, four undergraduate theses, an article in an international peer-reviewed journal; and two articles in a national peer-

reviewed journal, and one watermelon breeding/cultivating book will also be produced as part of the project

Research Project 5

Research Topic: Growth optimization of *Haematococcus Pluvialis* for astaxanthin and algal powder supplements

Duration of the Sub-project: 3 years

Total Cost of the Sub-project: US$ 380,927.56

Research Team: Dr HUY Hangsak (Principal investigator), Dr LONG Solida, Dr TIENG Siteng, Prof. Dr AHN Chi-Yong, Ms UNG Sivlin, and Mrs HUOY Laingshun

Haematococcus Pluvialis shows variables in astaxanthin synthesis that range from 2 to 5% in an aplanospore cell state depending on the environmental factors, nutritional stress, derivatives and plant hormones. Research is required to increase this concentration. It is hypothesized that the growth of microalgae and enhancement of astaxanthin production can be achieved through cultural optimization and genetic manipulation. This research has several specific objectives: (i) To isolate, identify and characterize novel microalgae, closely-related to strains to or sub-strains of *H. Pluvialis* and compare their cellular contents with the commercial strain, *H. Pluvialis* UTEX 2505; (ii) To optimize growth conditions including cultural media, micronutrient supplements, carbon-to-nitrogen sources and ratios, light irradiation, temperature, pH, or nitrogen limitation; (iii) To analyze the impact on the algal growth and astaxanthin synthesis caused by the microalgal associated-bacteria and plant hormones; (iv) To chemically induce

mutation in some strains and select the best grown and stress-tolerant microalgae, barring higher astaxanthin content.

Multiple methodologies will be used. *First*, to collect microalgae from the freshwater sample, identify their morphologies and genetics microscopic and 18S rDNA sequencing will be used. The associated bacteria will be confirmed by 16S rRNA sequencing. The novel strains confirmed by sequencing will be further characterized. The growth and carotenoid accumulation in the isolates will be analyzed by cell counting and pigment reading. *Second*, to optimize the best growing medium, micronutrient supplements, C and N sources, C/N ratios, N limitation, and environmental conditions for the growth and carotenoid accumulation in the standard strain UTEX 2505. The growth and carotenoids production from the isolate, UTEX 2505, and induced-mutant microalgae will be compared. The effect of associated-bacteria and several plant hormones such as abscisic acid, jasmonic acid, methyl jasmonate or growth regulators like gibberellic acid, salicylic acid or brassinosteroid-2,4-epibrassinolide on astaxanthin accumulation will also be tested using real-time (RT) qPCR amplification, cell counting methods, and pigment analysis. *Third*, to induction of the mutation in *H. Pluvialis* will be facilitated using the chemical mutagen, *N*-methyl-*N*-nitro-*N*-nitrosoguanidine (MNNG) to identify the best growth resistance under unfavourable growth conditions. *Fourth*, to extract and purify astaxanthin from the crude extract using the solvent base-extraction, the structure of astaxanthin will be analyzed by using NMR and HPLC. *Fifth*, to compare the ant oxidative activity of astaxanthin extracted from this study, it will be compared with a

commercial counterpart using mammalian cell lines and an anti-oxidative test kit. The expression of several antioxidant genes will also be confirmed by RT-qPCR amplification.

It is expected that various microalgae species will be isolated that have the potential to produce astaxanthin and other valuable sources of nutrition and that novel species of bacteria will be identified that may be grown with associated microalgae to explore their influence on microalgal cultivation. The optimal growth conditions, mutagenesis, and astaxanthin synthesis that will be discovered in this study will play an important role and produce fundamental knowledge for the future development of largescale production regimes. These results will be published in a local or international journal.

Research Project 6

Research Topic: Assessment of climate change risk and adaptation for the loss and damage of transportation infrastructures in Battambang and Prey Veng Provinces of Cambodia

Duration of the Sub-project: 3 years

Total Cost of the Sub-project: US$ 69,268.00

Research Team: Dr SPOANN Vin (Principal investigator), Dr SEAK Sophat, Dr NOP Sothun, Dr SAN Vibol, Dr THOUN Try, Dr YIM Mongtoeun, Mr SAT Sitak, Ms HOY Vannareth and Mr SE Bunleng

The Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) predicts that Asia will experience rises in temperature, longer summer heat spells, more intense and more frequent precipitation, increased extreme rainfall, a higher number of extreme tropical cyclones,

and rises in sea levels. The recent frequent occurrence of extreme weather events in Cambodia provides some evidence of increased intensity and frequency of climate events, which will potentially have negative impacts on urban and rural transportation infrastructure in Cambodia. Therefore, an improved understanding of loss and damage caused by extreme weather events, as well as the linkage between vulnerabilities, hazards and adaptive capacity, is critical. However, there is a shortage of practical methods for estimating loss and damage in the context of extreme climate events and transportation infrastructure (TI). Management of transportation infrastructure is a complex issue and there is limited knowledge of how to incorporate appropriate adaptation measures and strategies into rural and urban transport planning.

Therefore, this study has the following specific objectives: (i) To identify climate change-related hazards with potential impact on rural and urban TI; (ii) To characterize and classify types of urban and rural TI, identifying assets and inventories for each; (iii) To evaluate current losses and damage for TI in the context of climate change by rapid urban and rural assessments in the selected study sites of two provinces, and conduct detail vulnerability assessments (VA); (iv) To determine the loss and damage for each road infrastructure type in different climate change scenarios obtaining from the VA study; (v) To share study findings among stakeholders in the study sites through, policy discussion forum, publications and policy brief papers. This research presents a rapid assessment that will be conducted in Battambang

City and selected location in Prey Veng Province related to current losses and damages from extreme climate events.

The rapid assessment will be employed to assess current losses and damages to TI caused by main or extreme climate hazards, especially flooding, by applying an urban rapid assessment adopted from RRA, Impact Matrices and Multi-Criteria Analysis. Then, two research sites from each province will be used as a site for a vulnerability assessment (VA) at the community level. The scenarios will be created and an evaluation of assessment will be examined, as well as various adaptation measures. The NK-GIAS modelling package (GIS-based model) will be applied for estimating the economic loss and damage for TI associated with the major hazards.

This project will result in two scientific publications, two policy briefs and a manual guide on assessing climate risk on TI and will be of benefit to students and the research program of the Royal University of Phnom Penh and the Institute of Technology Cambodia. The project outputs will be shared with stakeholders through consultative workshops for further development of a set of guidelines/actions for climate change risk assessments to better understand losses and damages to TI and locally appropriate adaption measures.

Editorial: The importance of research policy at higher education institutions in Cambodia

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Today, high school graduates in Cambodia pay critical attention when selecting subjects for enrolment at university. It has become a significant decision that may impact their career choices. In promoting quality in education, universities have made efforts to integrate research in teaching and learning activities. Hyman and Jacobs (2010) identify ten reasons why research may be considered by students during the enrollment process: (1) the availability of experienced researchers; (2) courses incorporating the latest research; (3) energized faculty members; (4) opportunities to participate in collaborative research and internships; (5) fine-grained majors; (6) relationship building with graduate research students; (7) the possibility to publish research; (8) the possible admission to graduate and professional schools; (9) networking with well-known and distinguished people in their field; and (10) other opportunities to participate in graduate school programs. In Cambodia, undergraduate students with research achievements

often have the chance to become admitted to and financially supported to undertake post-graduate study in Cambodia or overseas.

Research-intensive universities playing an important role in advancing knowledge as well as supporting policies, planning and practice (Hellström, 2011). Research management at higher education institutions needs to be strengthened by establishing academic systems (Schimank, 2005) and assessments used to standardize measures of publication and citations (Hellström, 2011; Hicks, 2012). Thus, the process of transitioning toward a research-intensive university is expensive and requires more funds than what is generally available from public sources (West, 1988). In Cambodia, research funding has been mainly derived through international organizations, and bilateral or multilateral agencies. As a result, researchers can conduct research and publish papers based on their interests and passions. However, there are few mechanisms and support that may promote the development of a research culture at either the institutional or national level.

Homden (2019) suggests that research and educational experiences are different; however, students access significant benefits from faculties that conduct research. This is because they bring real-life experience from the field or experiments to teaching. In many countries, current research policy is dominated by managerialism and excellence, manifesting the aim of making universities into a national strategic asset that are globally competitive in the knowledge economy (Hallonsten and Silander, 2012). To operate a university, research policies are used to guide research-related activities

including processes to analyze important social and scientific problems to advance knowledge and solve problems. In 2019, the Research Office of the Royal University of Phnom Penh (RUPP) prepared a research policy through a participatory and consultative process. The RUPP Strategic Plan (2019–2023) placed special attention on both academic and applied research across the STEM, social sciences, and humanities disciplines.

This research policy includes a mission to be a place where researchers can access resources and form teams to develop evidence-based research. This policy aims to engender the creativity and innovation required to drive economic growth and social development. In achieving this vision and mission, ten strategies were proposed (Figure 1). The outcomes of these strategies are evident through the citation of RUPP affiliates in relevant databases, as well as the development of cross-institutional research centres across various fields. Moreover, RUPP has introduced a pilot university research grant in 2017. This initiative allocates university research grants to motivate researchers to publish their work in peer-reviewed journals. To enable this, RUPP has established various in-house, peer-reviewed journals. They include *'Insight: Cambodia Journal of Basic and Applied Research'*; the *'Cambodian Journal of Natural History'*; the *'Cambodian Review of Language Learning & Teaching'*; and the *'Cambodia Review of EFL Research'*.

The Royal Government of Cambodia through the Ministry of Education, Youth, and Sport promotes the publication of scientific research in the national higher education strategy. For instance, one of the eight key strategies in the Policy on Higher Education Vision 2030 is *'to ensure that*

RUPP staff and students, especially postgraduate students, contribute to improving the research and development culture in Cambodia to serve national development needs.' The publication of scientific research is considered to be a crucial aspect of promoting the Cambodian Industry 4.0 Policy. RUPP is one of the few public universities in Cambodia that possesses the capacity to produce quality research output. Over the first 5 years, the RUPP Policy on Research Development and Innovation will focus on the first two of three stages: Stage 1. Nurture a research culture and mobilize financial and human resources; Stage 2. Streamline research practices; and Stage 3. Deepen specific research areas.

Figure 1. The research strategy of the RUPP Strategic Plan (2019–2023)
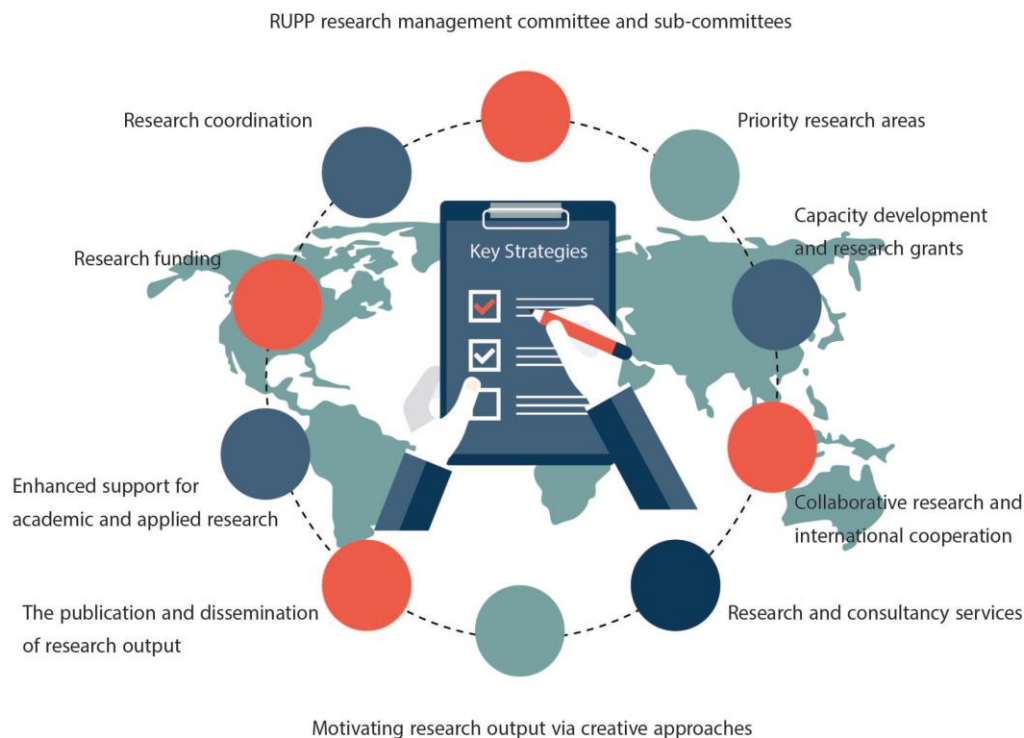
Source: RUPP, 2020

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The impact of international remittances from migrant workers in South Korea on the livelihoods of rural Cambodian households: A case study of Pea Reang District, Prey Veng Province

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សង្ខិត្តន័យ

អត្ថបទនេះ ស្វែងយល់ពីចរន្តនៃប្រាក់បញ្ជើរបស់ពលករចំណាកស្រុកកម្ពុជានៅប្រទេស កូរ៉េខាងត្បូង និងផលប៉ះពាល់លើជីវភាពគ្រួសារគាមទីជនបទនៃប្រទេសកម្ពុជា។ ការស្រាវជ្រាវនេះបានវិភាគទិន្នន័យតាមបែបបរិមាណវិស័យផង និងបែបគុណវិស័យផង ដោយសិក្សាលើគ្រួសារជនបទ ចំនួន៦៩គ្រួសារ ក្នុងឃុំរវា និងឃុំរុកា នៅស្រុកពារាំង ខេត្តព្រៃវែង។ បទសម្ភាសលម្អិតត្រូវបានធ្វើឡើងជាមួយពលករចំណាកស្រុកកម្ពុជា ក្នុងប្រទេសកូរ៉េខាងត្បូង មេឃុំ និងមន្ត្រីក្រសួងការងារ និងបណ្ឌះបណ្ឌាលវិជ្ជាជីវៈ កម្ពុជា។ ការសិក្សានេះបានរកឃើញថា ពលករកម្ពុជាភាគច្រើនត្រូវបានអូសទាញ ដោយប្រាក់បៀវត្សរ៍ច្រើន កង្វះឱកាសការងារក្នុងស្រុក និងជីវភាពក្រីក្រ ដែលជាកត្តា សំខាន់ចំពោះការងារចំណាកស្រុកនៅប្រទេសកូរ៉េខាងត្បូង។ ជាមួយប្រាក់បញ្ជើ

ជាមធ្យម ៧.០០០ដុល្លារអាមេរិកក្នុងមួយឆ្នាំ គ្រួសារពេលករតាមទីជនបទទាំងនោះ
បានចំណាយភាគច្រើនទៅលើមួបប្រចាំថ្ងៃ ការថែទាំសុខភាព ការជួសជុលកែលម្អផ្ទះ
ការសិក្សា និងគ្រឿងប្រើប្រាស់ផ្សេងៗទៀត។ ទោះបីជាប្រាក់បញ្ជើនេះបានផ្តល់នូវ
ផលវិជ្ជមានក្នុងរយៈពេលខ្លីក៏ពិតមែន ប៉ុន្តែប្រាក់បញ្ជើទាំងនោះអាចចាត់ទុកថាមាន
ប្រភពមិនស្ថិតស្ថេរ និងពុំអាចសង្ឃឹមលើបានឡូរអង្វែងទេ ប្រសិនបើគ្រួសារទាំង
នោះមិនបានយកប្រាក់បញ្ជើនោះទៅធ្វើការវិនិយោគសម្រាប់រយៈពេលវែងទេនោះ។

Abstract

This paper explores patterns in how remittances transferred by Cambodian labour migrants working in South Korea impact the livelihoods of rural households in Cambodia. A mixed-methods research design was used to develop a case study of 69 households in Reap and Roka communes in Pea Reang District, Prey Veng Province. In-depth interviews based on a semi-structured questionnaire were conducted with Cambodian migrant workers in South Korea, the respective commune chiefs, as well as officials from the Ministry of Labour and Vocational Training (MoLVT) in Cambodia. The majority of the Cambodian workers were found to migrate to South Korea by the higher salaries on offer. Other push-pull factors included a lack of local employment opportunities and the experience of poverty. The average annual remittance was found to be 7,000 USD, of which households spent mainly on food, health care, home renovation, education and property, among other expenses. Despite positive short-term impacts, remittances are considered to be an unreliable and insecure source of income if they are not used to invest in longer-term livelihood strategies.

Keywords: migrant worker, remittances, rural livelihoods, Cambodia, Prey Veng, South Korea

Background

International labour migration has become a key phenomenon influencing the global development agenda. For instance, the number of international migrants is estimated to have increased from 153 million to 272 million between 1999 and 2019, with almost two-thirds of this number being labour migrants (UN, 2019). It is expected that this figure will increase to 405 million by 2050 (IOM, 2010). Migrant labour from developing countries is estimated to account for 46% of total international migration (UN, 2019). In 2018, labour migrants accounted for 3.5% of the global population (WB, 2019). This has led to the twenty-first century labelled as the *"age of migration"* (Castles *et al.*, 2005).

International migrants have been shown to contribute both negatively and positively to the socio-economic development of developed (UN, 2016a) and developing (de Hass, 2006) countries. Negative impacts include a 'brain drain', or a loss of highly skilled workers; human rights violations; and school dropouts. Positive socio-economic impacts include a reduction in unemployment and underemployment; access to higher-paying jobs; and the return of workers with enhanced human, physical and social capital (WB, 2019). A rapid increase in the number of labour migrants reflects the growing significance of international migration as an integral part of the global economy (UN, 2016b). Therefore, well-managed international labour migration has the potential to result in beneficial outcomes, not only for each country involved but also to labour migrants and their families.

A dramatic surge in international labour migration has seen global remittances grow from an estimated 126 billion USD in 2000 to 689 billion USD in 2020 (UN, 2020). Between 2016 and 2019, the component of remittances to low- and middle-income countries increased from 429 billion USD to 554 billion USD (WB, 2020). International labour migration is driven by both push and pull factors, including socio-economic disparity, demographic trends, and increasingly sophisticated international transportation and telecommunication networks (IOM, 2010).

Remittances from international labour migrants are an important driver of socio-economic transformation, especially in developing countries (Bhagat *et al.*, 2013; Jha *et al.*, 2010; Tumbe, 2012). The growth of both migration and remittance flows has contributed to economic growth and poverty reduction in least developed countries (Gupta *et al.*, 2009; IOM, 2009) through indirect macroeconomic multipliers, as well as other factors (Ratha, 2007). Remittances have also been found to improve living conditions in the households that the workers migrate from (Cuecuecha, 2013; WB, 2016). For instance, remittances from migrant workers have been attributed to a reduction in poverty headcount ratio in several low-income countries (LICs) including Uganda (11%), Bangladesh (6%), and Ghana (5%) (Ratha, 2007).

International remittances tend to be targeted at meeting specific expenditure on daily living expenses, housing, education and health care (Derks, 2011; Sok, 2016); as a source of financial capital for small business and entrepreneurial activity; as well to pay for imports and external debt services (OECD, 2006; UNDP, 2011). For instance, remittances from migrant

workers were shown to be strongly associated with household investments in education, health care, as well as entrepreneurship in both El Salvador and Sri Lanka (UNDP, 2011). Remittances are an important factor in supporting household incomes and well-being in the country-of-origin of these migrant workers.

The importance of remittances in low- and middle-income countries is reflected in policies that allow citizens to work as labour migrants in high-income countries. The top destinations for these workers are the United States, followed by Saudi Arabia, Germany, Russia, the United Arab Emirates, the UK, France, Canada, Spain, and Australia (Ratha *et al.*, 2016; WB, 2019). In 2018, India was the largest recipient of documented remittance flows (78.61 billion USD), followed by China (67 billion USD), Mexico (35 billion USD), the Philippines (34 billion USD), Egypt (29 billion USD), and Nigeria (24.31 billion USD) (WB, 2020). Among Southeast Asian countries, the Philippines is the largest recipient of remittances, increasing from 26.9 billion USD in 2016 to 34 billion USD in 2018 (WB, 2020).

Cambodia as a lower-middle-income country has sent labour migrants to several middle and high-income countries including Thailand, Malaysia, and South Korea (Sorn, 2015). Between 2002 and 2007, Cambodia sent a growing number of labour migrants to work in South Korea through the Employment Permit System (EPS) (Kun, 2012; Maltoni, 2007). In 2016, 500 million USD in remittances was transferred by the Cambodian migrant workers to their households in Cambodia (Hang, 2017). Yet the contribution of international remittances to the national economy is not as significant as in the Philippines

due to differences in the English language proficiency of migrants from each country (Agcaoili, 2017; WB, 2016).

The growth in labour migration of Cambodian workers to South Korea is rooted in a range of push factors including poverty, homelessness, unemployment, lack of access to markets, loans or debts, natural disasters, and materialism. It is commonly believed that remittances are a viable household livelihood strategy. Remittances are primarily used to satisfy basic needs and repay debts (Derks, 2011:190), or in the case of migration to Thailand, used for food and health care, as well as to pay for debts accumulated as part of the migration processes (Maltoni, 2007).

Present studies have found that remittances are sent to the families of Cambodian migrant workers through visits by relatives and friends to and from each country (Sok, 2016), as well as various banking and financial services (WB, 2014). For instance, the documented transfer of remittances by Cambodian Americans fluctuated between 1992 and 2013, peaking in 2010. It is estimated that 273 million USD was sent from the United States to Cambodia between 2009 and 2012 (Sok, 2016). In total, according to the Central Bank of Cambodia, international remittances to Cambodia increased from 167 million USD in 2013 to 363 million USD in 2014. In the first quarter of 2015, 110 million USD in remittances were sent by Cambodian labour migrants, suggesting that annual remittances may reach 450 million USD (Sor, 2015).

Additionally, since 2002, millions of Cambodians have migrated to work overseas (Maza, 2017), with the number of undocumented migrant workers

possibly being higher than those who are documented (Derks, 2011). In 2006, the World Bank estimated that Cambodia received 298 million USD in remittances, accounting for 4.1% of GDP (WB, 2007). By 2016, the remittances transferred to Cambodia as a result of the Cambodia-South Korea Memorandum of Understanding (MOU) on migration exchange increased to 1.7 billion USD (UNDP, 2017). At this time, around 60,000 Cambodians were resident in South Korea, among whom 45,000 were migrant workers, contributing roughly 500 million USD in remittances (Hang, 2017).

The current literature on how remittances sent by Cambodian labour migrants have been used to contribute to household livelihoods is scarce. Therefore, this study develops a case study of Reap and Roka communes in Prey Veng Province to investigate this issue and contribute rigorous academic findings to labour migration policy of the Royal Government of Cambodia, international and local non-governmental organizations, and other stakeholders to further support, promote and protect Cambodian labour migration in South Korea.

Theoretical Framework

This research takes the pessimistic perspective of international migration of Birks & Sinclair (1979) as a theoretical framework to explore how remittances sent by migrant workers in South Korea contribute to the livelihoods of rural households in Cambodia. The perspective considers remittances to be an unreliable and unstable source of income for households, communities, and countries; as remittances end to rapidly

decline once migrants become settled, or upon the return of workers to their home country. By this lens, livelihoods are only improved temporarily and an unsafe dependency on this external revenue is created (Birks & Sinclair 1979, p.9; cited in de Haas 2007).

Figure 1. Theoretical framework
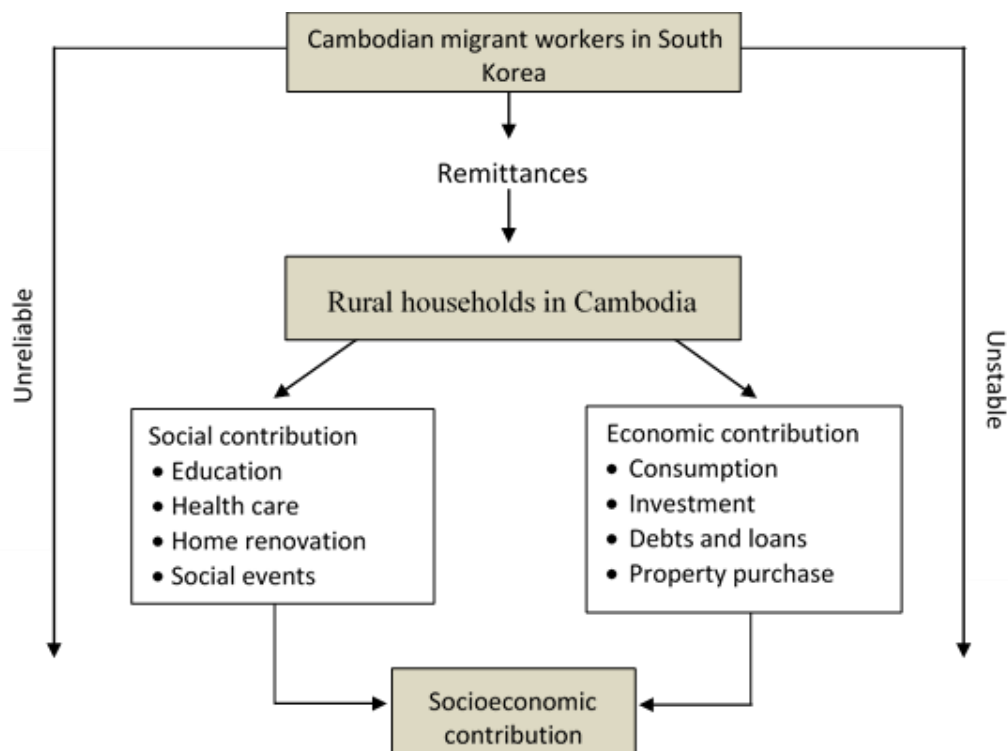
Adapted from Birks and Sinclair (1979)

The framework defines indicators such as education, health care, home renovations and social events are to test the social contribution of labour migration on households. Other attributes such as food, investments, the repayment of debts and loans, and property purchases are used to indicate an economic contribution. The framework is considered to be suitable for

this study as it can test whether international remittances to Cambodia have a negative or positive impact on household livelihoods (Figure 1).

Methodology

This exploratory mixed-methods study uses both descriptive statistics and in-depth interviews with key informants. Field research was conducted between November 2017 and April 2018 in Reap and Roka communes in Pea Reang District, Prey Veng Province. In total, 69 household surveys were conducted in the rural communes of Reap (38) and Roka (31). Three criteria were used to select the study area: (i) the number of labour migrants from the village who are working in South Korea and sending remittances to Cambodia; (ii) the significance of the remittances as a household income source; (iii) the significance of the remittances in terms of their contribution to socio-economic outcomes related to nutrition, healthcare, and education.

Key informant interviews were conducted with the commune chiefs in both Reap and Roka, as well as two officials from the Ministry of Labour and Vocational Training (MoLVT). In-depth interviews were also conducted with three Cambodian migrant workers currently working in different sectors in South Korea. In addition, 69 participants were sampled to participate in a quantitative survey, based on a research design with a precision level of 9%, using the below formula (Yamane, 1967). They were contacted directly and indirectly from the two study areas based on snowball sampling.

This study also draws from a variety of grey literature resources, including journal articles, books, working papers, newspapers and the bulletins of various organizations such as the United Nations, the

International Organization of Migration (IOM), and the International Labour Organization (ILO). Several official statements, reports and commentaries from the MoLVT in Cambodia and the Ministry of Education and Labor (MoEL) in South Korea were also used. Primary data was collected in the study areas using a reconnaissance survey, household surveys, as well as key informant and in-depth interviews based on a semi-structured questionnaire.

$$n = \frac{N}{1 + N\,(e)^2}$$

n = Sample size

N = Total population

e = level of precision

The study is primarily quantitative in approach. Quantitative data is substantiated by comparing the average number of household members with a national mean, to determine the average duration of stay of labour migrants in South Korea, as well as the timing and value of remittances received using a T-test. Chi-squared analysis was applied using categorical data to explore the significance of the relationship between push factors to send family members to South Korea and the impact on the livelihoods of the rural households surveyed. A weight averaged index (WAI) was used to evaluate the level of importance that households place on remittances and their impact on livelihoods on a five-point scale. Qualitative methods were used to support these results and explain trends in the use of the remittances by rural household in the study area.

Results and Findings
The employment of Cambodian labour migrant workers in South Korea

Cambodian labour migrants are generally recruited to work in South Korea using a government-to-government recruitment process, under an employment permit system. The South Korean MoEL and the Cambodian MoLVT work together closely to coordinate the recruitment process and select qualified Cambodians to fill labour shortages in South Korea. Candidates are required to submit an application for employment to the MoLVT and pass a Korean language test. Successful candidates are selected by companies in South Korea before receiving permission to legally migrate for work. Migrant labour regulations in South Korea restrict Cambodian migrant workers to a maximum of two terms. Each term is four years and ten months in duration. Migrant workers who demonstrate strong performance in their roles, and do not change their employer are rehired. They can continue their employment for a second term without retaking a language examination.

The in-depth interviews revealed that Cambodian migrant workers are provided with work permits and temporary residence cards on arrival in South Korea. The cards are used to record changes to the address and employer of each migrant worker. Generally, if workers periodically change their workplace during their first term, it is more difficult to access a second employment permit. Workers with multiple jobs in their first term are also viewed unfavorably. Employees are required to demonstrate diligence and loyalty to employers.

The survey accessed households who had at least one member immigrate to South Korea between 2005 and 2017 (Table 1). Households in

Roka began sending family members to attend training for employment in South Korea in 2005, before receiving employment eligibility. It was the first commune in Prey Veng to send Cambodian workers. As a result, the income accessed and experience with the labour migration program tends to be more positive than for migrant workers from Reap commune. The commune chief in Reap explained that villagers in his commune began migrating to South Korea after observing the positive experience of workers from Roka, where many households accessed benefits from the high incomes on offer in South Korea.

Each commune chief described a notable increase in the labour migration to South Korea starting in 2007 when a Memorandum of Understanding (MOU) on migration exchange and other regulations were agreed to by each national government. The trend declined temporarily in 2011 due to increased competition for employment in South Korea, before a second peak was reached in 2014 when the demand for 3D (dirty, dangerous and difficult) jobs increased. The number of households sending workers to South Korea from each commune gradually declined from that point up until 2017 (Figure 2).

The survey also found that young Cambodians migrate to South Korea because of the type of job opportunities available. They are not motivated to work in the traditional agricultural roles that are prevalent in Reap and Roka, where 98.73% and 93.23% of people who are employed, work as farmers (MoP, 2010). Young migrants tend to more highly paid work abroad in the industrial and service sectors.

Figure 2. Trends in Cambodian labour migration to South Korea between 2005 and 2017 from Roka and Reap Communes, Prey Veng Province
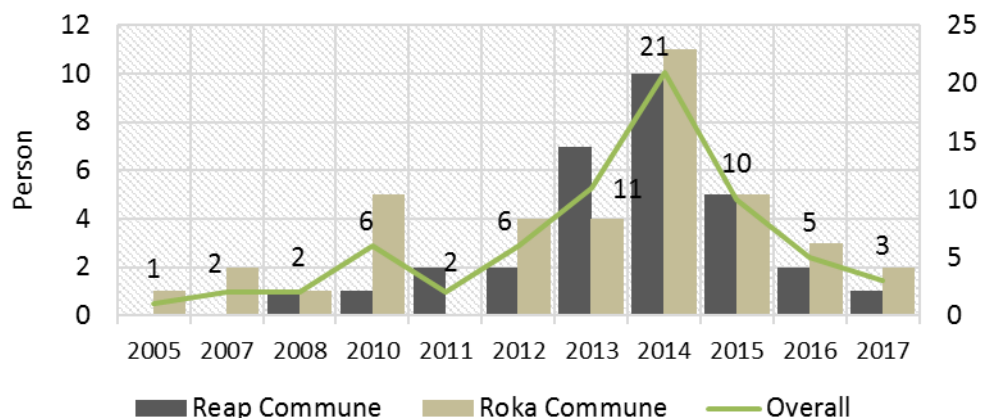
Source: MoP, 2017

Cambodian migrant workers were also found to stay in South Korea for an average period of 44.7 months or 3.73 years. A T-test revealed no significant difference in the duration of stay between each commune (Table 2).

Table 2. Duration of stay of Cambodian labour migrant workers in South Korea

Attributes	Reap	Roka	Overall
	(n=31)	(n=38)	(n=69)
Mean (month)	40.3	48.3	44.7
STD (month)	18.7	29.1	25.1

Notes: T-test results for the duration of stay of labour migrants between the two study areas (P=0.186)

Figure 3 shows that 81.2 % of the Cambodian workers changed their employment sector upon migrating. This is associated with the high demand for high demand labour-intensive industries. The most prominent of these

were found to be the agricultural (33.3%) and manufacturing (47.8%) sectors. Regardless of the type of job, many young Cambodians opt to give up studying and other small business opportunities at home communities to access higher-paying jobs in South Korea (Table 3).

Many reasons were identified as to why Cambodian workers decided to become labour migrants in South Korea (Table 4). The most significant pull-push factors were found to be higher salaries (98.6%), a lack of local jobs (72.5%), and poverty (60.9 %). Almost 77% of the population in Pea Reang District are farmers, with an average income of around 172 USD per month in 2016 (Provincial Planning Office, 2016). In comparison, migrant workers receive an average monthly salary of 1,573,770 WON (1,452 USD).

Figure 3. Trends in the employment of Cambodian migrant workers

N=56	Agriculture	Industry	Employee	Self-employment	Labour	Student	Unemployment	Overall	%
Agriculture	20	10	1	4	2	4	2	23	33.3
Industry	3	23	2	7	6	13	2	33	47.8
Employee	0	0	-3	0	0	0	0	0	0.0
Self-employment	0	0	0	-11	0	0	0	0	0.0
Labour	0	0	0	0	-8	0	0	0	0.0
Student	0	0	0	0	0	-17	0	0	0.0
Unemployment	0	0	0	0	0	0	-4	0	0.0
Overall	3	10	3	11	8	17	4	0	81.2
%	4.3	14.5	4.3	15.9	11.6	24.6	5.8		

Former occupation of labour migrant workers in Cambodia

Current occupation of migrant workers in South Korea

Other factors included following friends (39.1%), debt settlement (21.7%), modernization (21.7%), and skills improvement (18.8%). More

household in Reap (32.3%) than Roka (21.7%) were driven to migrate to pay off the debts, with the difference largely due to the cost of migration. Peer pressure was also influential, with, 32.3% of the migrant workers from Reap and 44.7% from Roka driven by this factor, following friends who had already accessed high salaries. Workers motivated to improve their skills (18.8%) may have been misguided as most industries in South Korea are based upon assembly systems that do not require high skill levels.

Trends in the transfer and expenditure of remittances

The remittances transferred by Cambodian migrant workers in South Korea to Cambodia were shown to have steadily increased over the last nine years (2007-2016), dependent on the types of employment accessed and the number of working hours. The survey indicates that the average annual remittances across both communes were around 7,000 USD, with households in Roka (7,612.5 USD) sending larger annual remittances than those from Reap (6,260.5 USD) per year. Yet, a T-test shows that this difference is not statistically significant (P=0.086). Among the respondents, 27.5% received more than 9000 USD annually. Around 20% of the households received a remittance of between 3,001 and 5,000 USD, or 7,001 to 9,000 USD, respectively. Further, 17.4% of received between 5,001 and 7,000 USD, while 14.5% received more than 1,000 but less than 3,000 USD (Table 5).

Households received remittances via three main channels including banks, friends, and brokers. Around one-third of surveyed households accessed remittances via informal brokers (31.6% in Roka and 35.5% in

Reap). Only 15.9% of households (13.2% in Roka and 19.4% in Reap) obtained the remittances through the friends of migrant workers who had visited family members abroad. This was shown to be a less popular strategy due to the frequency of visits and the cost of airfares.

Table 5. Amount of remittances transferred by Cambodian migrant workers

Attributes	Reap	Roka	Overall
	(n=31)	(n=38)	(n=69)
1001–3000	16.1	13.2	14.5
3001–5000	22.6	18.4	20.3
5001–7000	19.4	15.8	17.4
7001–9000	25.8	15.8	20.3
9001 and above	16.1	36.8	27.5
Average	6260.5	7612.5	7005.1

Most workers (88.4%) sent remittances via bank transfers (90.3% in Reap and 86.8% in Roka) with families preferring the services of Cambodian-based banks, such as Acleda, KB Kookmin, and the Wing International Money Transfer (IMT) due to the cost, reliability, and speed of the transfers. One migrant worker explained that he transferred a portion of his monthly salary via Hana Bank at 7 USD per transaction for any amount below 10,000 USD. This could be withdrawn at any Acleda branch in Cambodia within three hours of deposit at an additional cost of 10 USD (Table 6).

Remittances were shown to have positively contributed to household livelihoods, with remittances used for their daily food consumption (100%), health care (73.9%), home renovations (71%), education (55.1%), and property purchases (46.4 %). Some households spent remittances on social

events (36.2%), debt repayments (34.8%), and the development of small businesses (26.1%) (Table 7).

Table 6. Means of transferring remittances of Cambodian migrant workers in South Korea

Attributes	Reap		Roka		Overall	
	(n=31)		(n=38)		(n=69)	
	f	%	f	%	f	%
Cambodia-based banks	28	90.3	33	86.8	61	88.4
Friends visiting Cambodia	6	19.4	5	13.2	11	15.9
Brokers (informal channels)	11	35.5	12	31.6	23	33.3

A significant proportion of the remittances was allocated to daily food consumption. Many households also used the remittances to renovate housing, including the repair of walls, roofs and floors; repainting walls; or buying wooden furniture. Households in Roka were more likely to spend their remittance on home renovation (78.9%) than healthcare (71.1%), while in Reap the remittance was more likely to be spent on healthcare (77.4%) than home renovation (61.3%).

A more moderate share of the remittances was used to pay off the debts to banks, brokers, or microfinance organizations to attend the Korean language classes or pay other fees related to the processing of travel documents, living expenses in Phnom Penh, health check-ups, airfare and other expenses in preparation for migration to South Korea. Roughly one-third of households were found to have borrowed money to cover these expenses. Over half of households in both Reap (51.6%) and Roka 57.9 %

invested part of the remittance on their children's education. Around 26.1% (22.6% in Reap and 28.9% in Roka) of households invested their remittances in-home businesses, or another short-, medium-, and long-term investments. A moderate proportion of remittances was also used for social and cultural events, such as wedding receptions, parties, funerals, or other religious and animistic ceremonies such as *Pchum Ben*, *Bon Pka*, and *Katen*.

Table 7. Remittance expenditure in Reap and Roka commune

Attributes	Reap (n=31)		Roka (n=38)		Overall (n=69)	
	f	%	f	%	f	%
Daily food consumption	31	100.0	38	100.0	69	100.0
Education for children	16	51.6	22	57.9	38	55.1
Healthcare	24	77.4	27	71.1	51	73.9
Investments	7	22.6	11	28.9	18	26.1
Debt payments	14	45.2	10	26.3	24	34.8
Buying property	19	61.3	13	34.2	32	46.4
Home renovations	19	61.3	30	78.9	49	71.0
Social events	13	41.9	12	31.6	25	36.2

Working in South Korea was generally believed to be a strategy that could lead migrant workers and their families to become well off. Thus, seeking opportunities to migrate for work in South Korea has become a common ambition among young members of rural households in Cambodia. Table 6 presents the results of a Chi-squared test used to identify whether a correlation exists between the decision of the households to send a member to migrate for work in South Korea and a positive impact on living conditions

(Table 8). No significant correlation was found between these two factors (P-*value*=0.386).

Table 8. Relationship between Cambodian rural household's preference to continue sending household members to work in South Korea and effect on their living conditions

Attributes	Preference to continue sending family members to South Korea			X^2	P-*value*
		Yes	No	Overall		
Effect on households' living conditions	Yes	42	18	60	0.752	0.386
	No	5	4	9		
	Overall	47	22	69		

Perceived changes in household livelihoods and well-being

Households in Reap and Roka were found to hold different perceptions about their livelihoods and well-being before and after a member of the family had migrated to work in South Korea. A five-point WAI was used to measure the level of household satisfaction with these changes. The WAI used ten indicators related to living standards, education, healthcare, family happiness, investments, social participation, social status, housing conditions, lifestyle, and property ownership.

Further, a T-test was used to show that five indicators, including living standards, education, investment opportunities, housing conditions, and the lifestyles of surveyed households were significantly different between each case study commune. Livelihoods were shown to have improved as a result of labour migration to South Korea for 76% and 82% of households in Reap

and Roka, respectively. Households in Roka were highly satisfied with changes in their housing conditions (76%), education (65%), lifestyle (56%), and the level of household investments (47%). In Reap, however, households were only moderately satisfied with education (50%) and lifestyle (46%) factors, and less than satisfied with their level of household investments (34%) (Table 9).

Table 9. Perceived changes in household livelihoods and well-being in Reap and Roka

Attributes	Reap		Roka		Overall		P-*value*
	(n=31)		(n=38)		(n=69)		
	WAI	OA	WAI	OA	WAI	OA	
Living standards	0.76	H	0.82	VH	0.79	H	0.006**
Education	0.50	M	0.65	H	0.58	M	0.015**
Healthcare	0.71	H	0.77	H	0.74	H	0.076
Family happiness	0.71	H	0.77	H	0.74	H	0.059
Investment opportunities	0.34	L	0.47	M	0.41	M	0.026*
Social participation	0.58	M	0.62	H	0.60	M	0.359
Social status	0.65	H	0.69	H	0.67	H	0.084
Property ownership	0.61	H	0.66	H	0.64	H	0.08
Housing conditions	0.70	H	0.76	H	0.73	H	0.024*
Lifestyle	0.46	M	0.56	M	0.52	M	0.006**

Note: WAI= Weight Averaged Index measured on a five-point scale [Very Low (VL) =0.00-0.20, Low (L) =0.21-0.40, Moderate (M) =0.41-0.60, High (H) =0.61-0.80, Very High (VH) = 0.81-1.00]; OA= Overall Assessment; *Significance at the 0.05 level; **Significance at the 0.02 level.

Discussion
Divergence of trends in the transfer of remittances by commune

It is estimated that more than one million Cambodian migrant workers were residing outside Cambodia in 2017 (WB, 2017), among whom 5,967 Cambodians were legal or documented labour migrants in South Korea (MoLVT, 2017). The majority of legal migrants in South Korea work in four in-demand sectors including manufacturing, agriculture, construction, and fishery (see Appendix 1). Since 2010, the Cambodian workers in South Korea in these four sectors are reported to have collectively remitted close to 4 million USD (WB, 2016). This amount increased substantially from 3 million USD in 2010 to 8 million USD in 2015, before declining to 5 million USD in 2016. These figures may be contrasted with those from the Cambodian Embassy in South Korea, who reported that US$500 million was remitted by Cambodian labour migrant workers in South Korea in 2016 (Long Dimanch 2016; cited in Hang 2017).

This difference may be explained by three factors. First, the World Bank only tracked the periodic transfer of remittances by formal channels, such as international banks. However, 90.3% of migrants from Reap and 86.8% of migrants from Roka preferred to use Cambodia-based banks, such as Acleda, linking to Hana Bank through the Payone Program, Canadia Bank, and Wing-IMT. This was largely owing to lower transaction fees than international banking services, such as Western Union. Second, interviews reveal that some labour migrants found multiple jobs in South Korea to increase their income. One interviewee revealed that he worked in one officially registered full-time position, alongside another at night, without any formal registration. Another interviewee revealed that apart from a registered full-

time job, he also worked as a broker, helping other Cambodian labour migrants transfer remittances to Cambodia.

Third, a large proportion of the remittances were transferred by Cambodian migrant workers via other informal channels, such as friends and brokers. Despite their proficiency in Korean language, some migrant workers remained unfamiliar with formal banking services and technology, preferring to save their income and transfer it later via friends or brokers. One interviewee revealed that she was concerned about her level of computer literacy and language skills, preferring to send remittances to Reap commune through other workers in her factory. On average, 49.2% of the households sent remittances with friends who either did not charge a fee or only asked for a small payment for each transaction. The remittances of illegal labour migrant in South Korea are not able to be traced. It is estimated that between 3,000 and 4,000 Cambodians are residing illegally and working illegally in South Korea after overstaying their visa. These workers rely heavily on informal channels to transfer remittances

The causes of different socioeconomic outcomes in each study area

Rural households in Roka (7,613 USD per annum) were found to disproportionally benefit from labour migrations compared to those in Reap (6,261 USD per annum). While this difference is considered to be marginal, it may be attributed to four main factors. First, labour migrants from Roka tended to work for a longer duration in South Korea. Thus, they were able to access higher salaries due to their skill and experience developed over time.

Second, a correlation between the value of the remittances transferred and the frequency of communication with the household. In Roka, households were found to be in frequent contacted with family members in South Korea. They often discussed issues about finances and living conditions. For instance, one householder in Roka commune explained:

> *"My daughter moved to work in South Korea four years ago. I have maintained frequent contact with her via Facebook nearly every night. Since our family is large, we need some additional income to meet our household needs. When we talk, she sends us money and asks us to inform her if we need more."*

Third, the average number of household members in the study area is 5.5 people. This is markedly higher than the national average of 4.6 people (MoP, 2010). It was found that 15.8 % of households in Roka comprised between 7 and 9 members, compared to 25.8 % of households in Reap (see Appendix 2). This means that households in Reap shoulder a significant burden in terms of food consumption, health care, and education. A greater number of children in a household tends to result in a decline in the number of household members who participate in the labour force, particularly for women, thus, a decline in household income. Large households also save less and invest less in the education of their children. This perpetuates income inequalities as education is positively associated with higher income. Fourth, the number of families affected by unemployment, divorce, or the death of a household head is relatively higher in Reap. These households depend more heavily on immediate household members, who are not able to support their

extended family. There are a greater proportion of household members in Reap who are either unemployed or self-employed or who are aging and cannot undertake labor-intensive work in factories.

The negative impact of remittances on household livelihoods and well-being

Three major implications have been identified from the findings presented in this paper. First, at the end of their period of employment in South Korea, migrant workers are required to return to Cambodia. Often, they have not acquired knowledge or skills that are transferable and find it hard to access employment beyond the minimum monthly wage in Cambodia of around 190 USD per month. This is vastly different from what they would receive in South Korea and is highly demotivating particularly for those who value *'materialism'.* Second, a large proportion of remittances to households in Cambodia tend to be investments in home renovations that may be considered a liability; rather than an asset that may generate medium- or long-term profits, due to required expenditure on electricity, water, and maintenance.

Third, around half of the households in the two study areas overlooked the importance of long-term investments in the education of their children. This has tended to result in an ongoing intergenerational cycle of poverty, as education is positively linked to higher incomes. This is compounded by the presence of elders aged over 40, who nominally had poor access to education due to being born during or before the Khmer Rouge period between 1975 and 1979. During this time, schools and pagodas where basic

education was provided were completely shut down by the radical anti-intellectual regime. During the 1980s, the quality of education, particularly in rural areas was highly constrained. Most elders in the household that were surveyed did not receive a primary education.

In summary, the theoretical framework built on the pessimistic perspective of international migration adapted from Birks & Sinclair (1979) is a valid representation of the transfer remittances by Cambodian migrant workers in South Korea. They may be viewed as an unreliable source of household income. This is because remittances are primarily used for daily food consumption, home renovations, and other liabilities, rather than investments in assets such as home businesses. Households tend to become dependent on remittances as a significant source of household income that cannot be sustained.

Conclusion

The number of documented Cambodian labour migrant workers in South Korea increased from 468 in 2005 to 5,967 in 2017, representing an increase of 784.3%. This trend was replicated in the case study areas selected in this paper. Key motivating factors to migrate to South Korea include accessing more highly-paid employment, a lack of local jobs, and the experience of poverty. Other underlying factors include debt, modernization, peer pressure, skills improvement, materialism, as well as cultural experiences.

On average, Cambodian labour migrant workers in South Korea can earn 1,500 USD per month. Between 2007 and 2016, migrant workers in the case study areas remitted roughly 7,000 USD to Cambodia annually (7,612.5 USD

in Roka and 6,260.5 USD in Reap). This represents an 18% difference between each commune. Households in each commune obtained remittances via banking or financial services, friends, and/or informal brokers. The vast majority preferred to use Cambodia-based, rather than international banking services for these transfers. Almost one-third of the labour migrants surveyed in this study opted for less costly informal transaction services, such as brokers, friends, or colleagues.

The households in the case study used the remittances for their daily food expenses, healthcare, home renovations, education, property ownership, social events, debt settlement, and the development of small businesses. Food and health care expenses represent the most significant use of this income, followed by home renovations and education. Property ownership, higher-interest debt repayments and social or religious events, such as weddings and Buddhist ceremonies also accounted for a large share of the remittances.

Despite similar trends in the amount of remittances sent from South Korea to Cambodia, the two case study communes were impacted differently. Roka experienced better livelihood and well-being outcomes for four main reasons. First, household members from Roka migrated to South Korea for a longer period and thus were able to transfer a greater amount of remittances to improve the livelihoods of their households in Cambodia. Second, closer and more frequent levels of communication were maintained between migrant workers and their families, which is validated by the survey. Third, the size of households in each commune was different. In

comparison to Roka, Reap had a larger number of members per household and thus, had a greater proportion of burdens to support with the remittances sent. Finally, unemployment, divorce and single-headed households are more prevalent in Reap.

While remittances have contributed to the overall socio-economic development of rural communities in Cambodia over the past nine years, many households have not utilized them to invest in assets, preferring expenditure on home decoration and materialist tendencies. Thus, it is concluded that remittances are an artificial and temporary source of improvement in household livelihoods and remain an unreliable and unstable source of income. The families of labour migrants should be encouraged to invest more in the education of children, skills improvement and investment in small businesses. Otherwise, a perpetual dependency on these external revenues and a continuing cycle of poverty is likely to prevail.

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Appendix

Table 1. Demographic Information of Respondents in Reap and Roka

Attributes	Reap (n=31)	Roka (n=38)	Overall (n=69)
Age group (%)			
30 and below	16.1	7.9	11.6
31-40	12.9	10.5	11.6
41-50	19.4	21.1	20.3
51 and above	51.6	60.5	56.5
Average (years)	*47.7*	*51.8*	*49.9*
Educational Level (%)			
Illiterate	3.2	2.6	2.9
Primary level	32.3	39.5	36.2
Lower secondary level	41.9	36.8	39.1
Upper secondary level	22.6	21.1	21.7
Average (Grade)	*7.3*	*6.7*	*7.0*
Household members (%)			
3 and below	0.0	5.3	2.9
4-6	74.2	76.3	75.4
7-9	25.8	15.8	20.3
10 and above	0.0	2.6	1.4
Average (people)	*5.8*	*5.3*	***5.5*** [1,a]
Marital Status (%)			
Single	0.0	2.6	1.4
Married	90.3	86.8	88.4
Divorced	3.2	0.0	1.4
Widow	6.5	10.5	8.7

Note: Significant P Values are shown in bold font.
[1]Significant at 0.000%; [a] National household size of 4.6 persons

Table 3. Number of Cambodian labour migrant workers in South Korea in sectors

Sector	2014[b]	2015[b]	2016[c]	2017[c]
Manufacturing	4,371	4,309	4,737	2,730
Agriculture	2,635	2,633	1,960	2,677
Fishery	8	4	0	0
Construction	657	886	674	560
Overall	7,671	7,832	7,371	5,967

Sources: [b]Ministry of Labour and Vocational Training, 2016; [c]Ministry of Labour and Vocational Training, 2017

Note: The data on the number of Cambodian migrant workers above were selectively compiled based on three documents: one policy and two annual reports of the Cambodian Ministry of Labour and Vocational Training.

Table 4. Drivers of Cambodian labour migration to South Korea

Attributes	Reap		Roka		Overall	
	(n=31)		(n=38)		(n=6)	
	f	%	f	%	f	%
Poverty	26	83.9	16	42.1	42	60.9
Lack of local jobs	19	61.3	31	81.6	50	72.5
Debt settlement	10	32.3	5	13.2	15	21.7
Good salary	31	100.0	37	97.4	68	98.6
Materialism	1	3.2	2	5.3	3	4.3
Modernization	5	16.1	10	26.3	15	21.7
Skills improvement	7	22.6	6	15.8	13	18.8
Cultural influences	1	3.2	1	2.6	2	2.9
Following friends	10	32.3	17	44.7	27	39.1
Other reasons	0	0.0	1	2.6	1	1.4

ខ្នាតវ្រាស់តម្លាភាព គណនេយ្យភាព និងការចូលរួមពី ភាគីពាក់ព័ន្ធស្តីពីការប្រើប្រាស់ថវិកាកម្មវិធីនៅគ្រឹះស្ថាន ឧត្តមសិក្សាសាធារណៈមួយនៅព្រះរាជាណាចក្រកម្ពុជា ដោយផ្អែកលើទ្រឹស្តី ˝អភិបាលកិច្ចល្អ˝

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សង្ខិត្តន័យ

នៅឆ្នាំ២០០៤ ផែនការកំណែទម្រង់ហិរញ្ញវត្ថុសាធារណៈរបស់រាជរដ្ឋាភិបាលមានបួន ដំណាក់កាល ក្នុងនោះ មានទាំងការដាក់ចេញនូវគោលនយោបាយហិរញ្ញប្បទាន របស់ក្រសួងអប់រំ យុវជន និងកីឡា ក៏ដូចជាសម្រាប់ឧត្តមសិក្សាសាធារណៈ ក្នុង គោលដៅលើកកម្ពស់អនុកម្មវិធីឧត្តមសិក្សាទាំង១២។ ការសិក្សាស្រាវជ្រាវនេះផ្តោត សំខាន់លើខ្នាតវ្រាស់ទាំងបី នៃការអនុវត្តថវិកាកម្មវិធីនៅគ្រឹះស្ថានសិក្សាសាធារណៈ ដែលរួមមាន៖ (១) ការចូលរួមពីភាគីពាក់ព័ន្ធ (២) តម្លាភាព និង (៣) គណនេយ្យ ភាព។ ការស្រាវជ្រាវនេះបង្ហាញថា តម្លាភាពនិងគណនេយ្យភាពនៃការអនុវត្តថវិកា ដែលបាននឹងកំពុងអនុវត្តនៅមានកម្រិតនៅឡើយ ព្រោះគ្រប់ការអនុវត្តថវិកាមានភាព ឆ្លើយតបទៅនឹងផែនការសកម្មភាពតិច និងមិនចំគោលដៅរបស់ការិយាល័យ មហា វិទ្យាល័យ និងដេប៉ាតឺម៉ង់។ ម្យ៉ាងទៀតរាល់ព័ត៌មានហិរញ្ញវត្ថុ និងគណនេយ្យមិនបាន ផ្សព្វផ្សាយឱ្យទូលំទូលាយនៅក្នុងអង្គភាពថវិកានៅឡើយ។ ការស្រាវជ្រាវបង្ហាញផង

ដែរថា ការចូលរួមពីភាគីពាក់ព័ន្ធក៏នៅមានកម្រិតទាបដែរ ព្រោះ ជាទូទៅ រាល់ការ សម្រេចចិត្តផ្នែកថវិកាកម្មវិធីត្រូវបានធ្វើឡើងគ្រឹមគណៈគ្រប់គ្រងជាន់ខ្ពស់ និងផ្នែករ ដ្ឋទេយ្យតែប៉ុណ្ណោះ ចំណែកភាគីពាក់ព័ន្ធដទៃទៀតត្រូវចាំទទួលយកកញ្ចប់ថវិកាទៅ អនុវត្តផែនការសកម្មភាពតែម្ដង។

Abstract

In 2004, the Public Financing Reform Plan of the Royal Government of Cambodia was released. It comprised four phases, including the launch of the financing policy for public universities developed by the Ministry of Education, Youth and Sport. This study focuses on the three criteria used for implementing program budgets in public higher education institutions: transparency, accountability, and stakeholder engagement, which are implemented through twelve sub-programs. It demonstrates that the transparency and accountability of budgets are still limited, evidenced by the lack of responsiveness to budget allocations outlined in the action plans of relevant departments within higher education institutions. While financial information is widely disseminated, the participation of stakeholders in research activities is constrained as decisions about program budgets tend to be made only by the senior management, while other stakeholders are required to accept allocated budgets for implementing their action plans.

Keywords: transparency, accountability, stakeholder engagement, public universities

សេចក្ដីផ្ដើម

ថវិកាដែលរាជរដ្ឋាភិបាលចំណាយលើវិស័យឧត្តមសិក្សា ប្រែប្រួលទៅតាមសម័យកាល និងរបបគ្រប់គ្រងរដ្ឋ។ យើងពុំឃើញមានរូបរាងពិតប្រាកដនៅសម័យមុនអង្គរ និងសម័យ អង្គរទេ។ សម័យក្រោយអង្គរនិងសម័យអាណានិគមនិយមបារាំងក៏ពុំមានគន្លងលខច្បាស់លាស់ ដែរ។ ដោយឡែកនៅសម័យសង្គមរាស្ត្រនិយម ពីឆ្នាំ១៩៥៣-១៩៦៤ រាជរដ្ឋាភិបាលបាន ចំណាយថវិកាលើវិស័យអប់រំខ្ពស់ជាងវិស័យការពារជាតិ គឺពី ១៥.៥៩% ដល់ ២២.៥៦% (Lee C & Gildas, 26 (1), 1997)។

ឆ្នាំ១៩៥៣ ក្រោយកម្ពុជាទទួលបានឯករាជ្យបរិបូរណ៍ពីអាណានិគមនិយមបារាំង ពេល
គឺនៅសម័យសង្គមរាស្ត្រនិយម ក្រោមព្រះរាជដឹកនាំរបស់សម្តេចព្រះនរោត្តមសីហនុ រាជរដ្ឋាភិបាល
សង្គមរាស្ត្រនិយមបានចំណាយថវិកាជាតិប្រមាណជា ២០% នៃថវិកាជាតិសរុប ដើម្បីពង្រឹង
ប្រព័ន្ធអប់រំនៅឧត្តមសិក្សាមានការប្រកួតប្រជែងទូទាំងអាស៊ីអាគ្នេយ៍ និងដើម្បីលុបបំបាត់ផ្ដាច់
គំនិតអាណានិគមបារាំង និងបណ្ដុះផ្ដត់គំនិតជាតិនិយម (Clayton, 34 (4) 2005)។

នៅចន្លោះឆ្នាំ១៩៧០ និង ១៩៨៣ កម្ពុជារងគ្រោះដោយសារសង្គ្រាមរាំរ៉ៃ។ ប៉ុន្តែ ចាប់ពី
ឆ្នាំ២០០០ ដល់ ២០១០ រាជរដ្ឋាភិបាលបានវិនិយោគថវិកាលើវិស័យអប់រំផ្នែកឧត្តមសិក្សា
គួរឲ្យកត់សម្គាល់។ ជាក់ស្ដែងក្នុងឆ្នាំ២០១០ ដើម្បីពង្រឹងអនុវិស័យឧត្តមសិក្សានៅប្រទេស
កម្ពុជា រាជរដ្ឋាភិបាលបាននិយោគទៅលើផ្នែកឧត្តមសិក្សាក្រោមគម្រោង (HEQCIP) គិតជា
ទឹកប្រាក់សរុបប្រមាណ ២៣លានដុល្លារ សម្រាប់រយៈពេល៥ឆ្នាំ។ គម្រោងវិនិយោគនេះគឺ
ដើម្បីពង្រឹងសមាសភាគគន្លឹះចំនួន ៤[1] ផ្សេងៗនៅឧត្តមសិក្សា (Rappleye and Un, 2018)។
ឆ្នាំ២០១០ ដដែលនេះ ដើម្បីពង្រឹងសមត្ថភាពការអប់រំនៅគ្រឹះស្ថានឧត្តមសិក្សា ក្រសួងអប់រំ
បានចំណាយថវិកាមួយភាគបីនៃថវិកាសរុបរបស់ខ្លួន (Kuy, 2013)។ ឆ្នាំ២០១២ រាជរដ្ឋាភិ
បាលបានផ្ដល់ថវិកាទាបសម្រាប់អនុវិស័យឧត្តមសិក្សា ដោយទទួលបានត្រឹមតែ ០,១% នៃ
GDP ឬ ៤,១% នៃថវិកាសរុបរបស់ក្រសួងអប់រំ យុវជន និងកីឡា (Sen, 2017)។

ចំពោះហិរញ្ញប្បទានមាន ៤% នៃថវិកាប្រចាំឆ្នាំរបស់ខ្លួនសម្រាប់អនុវិស័យឧត្តមសិក្សា។
ប៉ុន្តែ ចាប់ពីឆ្នាំ ២០១៤ រហូតដល់ឆ្នាំ ២០១៨ ថវិកាចំណាយផ្នែកឧត្តមសិក្សាមានការកើន
ឡើងជាលំដាប់ (UNESCO, 2015)។ ជាក់ស្ដែង គេឃើញការចំណាយថវិកាមកលើផ្នែក
ឧត្តមសិក្សាមានការកើនឡើងគឺ ២១០,០៥ ពាន់លានរៀលក្នុងឆ្នាំ២០១៤, ២៤៦,៥៦០
ពាន់លានរៀលក្នុងឆ្នាំ២០១៥, ២៧២,៤៦៩ ពាន់លានរៀលក្នុងឆ្នាំ២០១៦, ៣១៣,៩៩៧
ពាន់លានរៀលក្នុងឆ្នាំ២០១៧ និង ៣៩២,៦៣៦ ពាន់លានរៀលក្នុងឆ្នាំ២០១៨ (ក្រសួង
អប់រំ យុវជន និងកីឡា, ២០១៤-២០១៨)។ ក្របខណ្ឌហិរញ្ញប្បទានវិស័យអប់រំមានទំនាក់
ទំនងយ៉ាងជិតស្និទ្ធទៅនឹងថវិការាជរដ្ឋាភិបាល។ ភាគច្រើននៃកម្មវិធីអាទិភាពត្រូវបានអនុវត្ត
ដោយប្រើប្រាស់ថវិកាចរន្តរបស់ក្រសួងអប់រំ យុវជន និងកីឡា។ នាពេលបច្ចុប្បន្ន ហិរញ្ញប្បទាន

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[1] សមាសភាគគន្លឹះទាំង ៤ របស់គម្រោង HEQCIP នោះគឺ (១) ពង្រឹងសមត្ថភាពនៃការអប់រំឧត្តមសិក្សា, (២) ជំនួយអភិវឌ្ឍ
ន៍និងផ្ដល់ការអភិវឌ្ឍប្រកបដោយការប្រកួតប្រជែង, (៣) ផ្ដល់អាហារូបករណ៍ដល់សិស្ស-និស្សិតដែលងាយរងគ្រោះ និង (៤)
ការត្រួតពិនិត្យគម្រោងនិងការវាយតម្លៃ។

ខាងក្រៅក្នុងវិស័យអប់រំត្រូវបានផ្តល់តាមរយៈថវិកាគាំទ្រ គម្រោងវិនិយោគមូលធន គម្រោង
កសាងសមត្ថភាព និងកម្មវិធីជំនួយអាទិភាពចន្លោះមួយចំនួនទៀត។ ចំណាយសាធារណៈសរុបលើ
វិស័យអប់រំគឺជាផលបូកចំណាយនៃថវិកាជូន កម្មវិធីជំនួយ និងកម្មវិធីគាំទ្រ។ គោលដៅនៃ
ក្រសួងអប់រំ យុវជន និងកីឡា គឺបង្កើតនូវសេវាអប់រំប្រកបដោយសមភាពក្នុងការទទួលបាន
និងមានគុណភាពខ្ពស់។

ចក្ខុវិស័យក្រសួងអប់រំ យុវជន និងកីឡា គឺការស្វែងយល់ពីតម្រូវការចាំបាច់នៃប្រព័ន្ធ
បណ្ដុះបណ្ដាលនិងអប់រំ ដើម្បីជួយជំរុញកំណើនសេដ្ឋកិច្ច បង្កើនលទ្ធភាពបានការងារ និង
បង្កើនឱកាសរកប្រាក់ចំណូល។ ជាងនេះទៅទៀត ចំណាយលើប្រាក់បៀវត្សមានចំនួន
១,៦២៧ ពាន់លានរៀល ដែលស្មើនឹង ១៣,៦៧% នៃចំណាយចរន្ត (ហង់, ២០១៦)។
ការដាក់ចេញនូវគោលនយោបាយហិរញ្ញប្បទានរបស់ក្រសួងអប់រំ យុវជន និងកីឡា ក៏ដូចជា
សម្រាប់ឧត្តមសិក្សាសាធារណៈក្នុងគោលដៅលើកកម្ពស់អនុកម្មវិធី ឧត្តមសិក្សាចំនួន ១២[2]
(ក្រសួងអប់រំ យុវជន និងកីឡា, ២០១៤-២០១៨)។ ក្របខណ្ឌអភិបាលកិច្ចល្អ ការអនុវត្ត
វិស័យអប់រំឆ្នាំ២០៣០ នឹងតម្រូវឱ្យមានយន្តការថ្នាក់ជាតិ ថ្នាក់តំបន់ និងថ្នាក់សកលសម្រាប់
អភិបាលកិច្ច គណនេយ្យភាព ការសម្របសម្រួល ការរៀបចំតាមដាននិងការពិនិត្យឡើងវិញ
ការវាយការណ៍និងការវាយតម្លៃ(UNESCO, 2015)។

អំពីអភិបាលកិច្ច តម្លាភាព គណនេយ្យភាព និងភាគីពាក់ព័ន្ធ

តាមការស្រាវជ្រាវវិនានា មានទស្សនៈជាច្រើនផ្សេងៗគ្នាអំពី "អភិបាលកិច្ច"។ ដំបូងឡើយ
"អភិបាលកិច្ច" ត្រូវបានប្រើដើម្បីពណ៌នាពីតម្រូវការសម្រាប់កំណែទម្រង់ស្ថាប័ន និងវិស័យ
សាធារណៈ ឱ្យមានប្រសិទ្ធភាពនិងប្រសើរជាងមុននៅក្នុងប្រទេសអនុតំបន់សាហារ៉ាអាហ្រ្វិក។
តាមលោក Barber Conable (1986-1991) អតីតប្រធានធនាគារពិភពលោក "អភិបាលកិច្ច

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[2] អនុកម្មវិធីអាទិភាពទាំង ១២ នៃការប្រើប្រាស់ថវិកាសម្រាប់ឧត្តមសិក្សាគឺ **អនុកម្មវិធីទី១** ការលើកកម្ពស់គុណភាព និងការឆ្លើយ
តបនៃការអប់រំឧត្តមសិក្សា, **អនុកម្មវិធីទី២** ការពង្រឹងគុណភាព និងការឆ្លើយតបនៃការបណ្ដុះបណ្ដាលក្របិតឧត្តម និងក្រោយ
ឧត្តមប្រកបដោយប្រសិទ្ធភាព, **អនុកម្មវិធីទី៣** ការពង្រឹងគុណភាព ប្រសិទ្ធភាពនៃការបណ្ដុះបណ្ដាល និងស្រាវជ្រាវ, **អនុកម្មវិធី
ទី៤** លើកកម្ពស់គុណភាពនៃការបណ្ដុះបណ្ដាល និងស្រាវជ្រាវ, **អនុកម្មវិធីទី៥** ការអភិវឌ្ឍការបណ្ដុះបណ្ដាល និងស្រាវជ្រាវ,
អនុកម្មវិធីទី៦ ការពង្រឹងគុណភាព និងប្រសិទ្ធភាពនៃការបណ្ដុះបណ្ដាល និងស្រាវជ្រាវ, **អនុកម្មវិធីទី៧** ការលើកកម្ពស់
គុណភាពនៃការបណ្ដុះបណ្ដាល និងស្រាវជ្រាវ, **អនុកម្មវិធីទី៨** ការពង្រឹងគុណភាព និងប្រសិទ្ធភាពនៃការបណ្ដុះបណ្ដាលនិង
ស្រាវជ្រាវ, **អនុកម្មវិធីទី៩** ការពង្រឹងគុណភាព ប្រសិទ្ធភាពអប់រំ និងការស្រាវជ្រាវ, **អនុកម្មវិធីទី១០** ការទទួលស្គាល់គុណភាព
អប់រំឧត្តមសិក្សា, **អនុកម្មវិធីទី១១** ការពង្រឹងគុណភាព និងប្រសិទ្ធភាពនៃការបណ្ដុះបណ្ដាល ការស្រាវជ្រាវ និងសេវាសហគមន៍
, **អនុកម្មវិធីទី១២** ការពង្រឹងគុណភាព និងប្រសិទ្ធភាពនៃការបណ្ដុះបណ្ដាល និងស្រាវជ្រាវ។

ល្អ�" គឺសំដៅលើសេវាសាធារណៈដែលមានប្រសិទ្ធភាព ប្រព័ន្ធតុលាការដែលអាចទុកចិត្តបាន និងរដ្ឋាបាលដែលមានគណនេយ្យភាពចំពោះសេវាសាធារណៈនោះ។

ឆ្នាំ១៩៨២ ធនាគារពិភពលោកប្រើជា ``អភិបាលកិច្ចនិងការអភិវឌ្ឍ" ដែលមានន័យថា លក្ខណៈនៅក្នុងអំណាចដែលត្រូវបានអនុវត្តក្នុងការគ្រប់គ្រងស្ថាប័នមួយ និងការបែងចែក ធនធានសេដ្ឋកិច្ចនិងសង្គមសម្រាប់ការអភិវឌ្ឍ។ ឆ្នាំ១៩៨៥ ធនាគារពិភពលោកបានបញ្ជាក់ បន្ថែមថា ``អភិបាលកិច្ច" ត្រូវបានបង្ហាញដោយការព្យោករណ៍បើកចំហ និងការបង្កើត គោលនយោបាយបំភ្លឺ (នោះគឺតម្លាភាព)។ ឆ្នាំ១៩៨៩ កម្មវិធីអភិបាលកិច្ចអាស៊ីប្រែពីវិបត្ត ទៅជាឧិកាស។ ការបោះពុម្ពផ្សាយប្រចាំឆ្នាំរបស់ធនាគារពិភពលោកពេលនោះ ``អភិបាល កិច្ច" មានសមាសធាតុធំៗបួនគឺៈ (១) គណនេយ្យភាព (២) តម្លាភាព (៣) អាចប៉ាន់ ប្រមាណបាន និង (៤) ការចូលរួមពីភាគីពាក់ព័ន្ធ (Tripathi, 2017)។ ម្យ៉ាងទៀត ``អភិបាលកិច្ច" គឺជាការប្រើប្រាស់អំណាចនយោបាយ។ កម្មវិធីអភិវឌ្ឍអង្គការសហប្រជាជាតិ ``អភិបាលកិច្ច" គឺការធ្វើលំហាត់នយោបាយសេដ្ឋកិច្ច និងអាជ្ញាធររដ្ឋបាលក្នុងការគ្រប់គ្រង គ្រប់លំដាប់ថ្នាក់ (Tripathi, 2017)។

ឆ្នាំ២០១០ តាមធនាគារពិភពលោក ``អភិបាលកិច្ច" មានសមាសភាពបួនដដែល តែមាន ការកែប្រែបន្តិចបន្តួចគឺៈ (១) សេវាគ្រប់គ្រងសាធារណៈ (២) គណនេយ្យភាព (៣) នីតិរដ្ឋ និងការអភិវឌ្ឍ និង (៤) តម្លាភាពនិងប្រព័ន្ធព័ត៌មាន, (Maldonado, 2010)។ ម្យ៉ាងទៀត ``អភិបាលកិច្ច" អាចមានសមាសភាគប្រើនជាងនេះគឺៈ (១) ការចូលរួម (២) ភាពស៊ីសង្វាក់ គ្នាក្នុងអង្គភាព (៣) គណនេយ្យភាព (៤) តម្លាភាព (៥) ទំនួលខុសត្រូវ (៦) ប្រសិទ្ធភាព និងភាពសក្តិសិទ្ធិ (៧) សមធម៌និងបរិយាប័ន្ន[3] (៨) អនុវត្តតាមនីតិរដ្ឋ (Arulrajah, 2016)។ ដោយឡែក បញ្ញត្តិនៃអភិបាលកិច្ចល្អនៅប្រទេសអង់គ្លេសត្រូវបានរាស់ដោយ ឧបករណ៍ធំៗពីរគឺៈ (១) តម្លាភាព និង (២) គណនេយ្យភាពបែបប្រជាធិបតេយ្យតាមរយៈ ការប្រើប្រាស់ថវិកាកម្មវិធី (PB) ក្នុងទីក្រុង និងរដ្ឋាបាលក្រុង។ ឧបករណ៍ទាំងពីរនោះត្រូវបាន ប្រើដើម្បីវាស់ឲ្យដឹងថាៈ (១) តើថវិកាកម្មវិធីអាចធ្វើឲ្យប្រសើរឡើងនូវតម្លាភាព គណនេយ្យភាព

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[3] បរិយាប័ន្ន ស្មើរប្រើបទ្រេកសព្ទនេះក្នុងន័យសងគ្រឡប់ទៅនឹងបទ្រេកសព្ទភាសាអង់គ្លេសថា inclusive ដែល តាមវចនានុក្រមពីរភាសាអង់គ្លេស-ខ្មែរពន្យល់ថា ``ដែលមាននៅក្នុង, ដែលរាប់បញ្ចូល, ដែលបំព្រួញ, ដែលយល់ ច្បាស់, ..."។

និងលទ្ធិប្រជាធិបតេយ្យក្នុងក្រុង និងរដ្ឋបាលក្រុងឬទេ? (២) តើចរិកកម្មវិធីជាឧបករណ៍សម្រាប់សម្រួលរវាងការគ្រប់គ្រង តម្លាភាព និងលទ្ធិប្រជាធិបតេយ្យក្នុងក្រុង និងរដ្ឋបាលក្រុងឬទេ? (Maria Isabel Brun-Martos et al. 2016)។

ចំណែកកម្មវិធីអភិវឌ្ឍធនធានមនុស្សសកល អភិបាលកិច្ចល្អមានសមាសភាគចំនួន១០ គឺ៖ (១) ការចូលរួម (២) គណនេយ្យភាព (៣) ការមិនរើសអើង (៤) សមភាព (៥) សហប្រតិបត្តិការ (៦) តម្លាភាព (ភាពជាម្ចាស់ ភាពត្រឹមត្រូវ) (៧) ប្រព័ន្ធបច្ចេកវិទ្យា (៨) ការផ្តល់ឱកាសដល់ផ្នែកសេវាសាធារណៈ (៩) ភាពស្របច្បាប់ (១០) រដ្ឋអធិបតេយ្យ/ នីតិរដ្ឋ ដែលទាំងអស់នេះ៖ រដ្ឋាភិបាលត្រូវបានបង្កើតឡើងដើម្បីធ្វើឱ្យមានអភិបាលកិច្ចធនធានមនុស្ស ឬអភិបាលកិច្ចសកល (Weiss, 2010)។

លើសពីនេះទៅទៀត "អភិបាលកិច្ច" ជាពាក្យចេញពីរដ្ឋាភិបាលតែម្តង គឺជាអ្នកគ្រប់គ្រង អ្នកបីបាច់រក្សា អ្នកថែរក្សា ការគ្រប់គ្រង ការបីបាច់ ការរក្សា។ ចំណែកពាក្យ "រដ្ឋាភិបាល" មានភាពស្ថិតស្ថេរនិងបង្ហាញពីចរិតលក្ខណៈ ឬសកម្មភាពរបស់រដ្ឋាភិបាល (Choun, 1967)។ ម្យ៉ាងទៀត ក្រសួងមហាផ្ទៃនៃព្រះរាជាណាចក្រកម្ពុជាក៏បានយកចិត្តទុកដាក់ចំពោះបញ្ញត្តិនេះ ផងដែរថា "អភិបាលកិច្ចល្អ" គឺជាបុរេលក្ខខណ្ឌសំខាន់បំផុតមួយ ដើម្បីធានាឱ្យមានការអភិវឌ្ឍសេដ្ឋកិច្ចសង្គម ប្រកបដោយចីរភាព សមធម៌ និងយុត្តិធម៌ក្នុងសង្គម (ក្រសួងមហាផ្ទៃ, ឆ្នាំ ២០១៣)។

រាជរដ្ឋាភិបាលនៃព្រះរាជាណាចក្រកម្ពុជាក៏បានធ្វើកំណែទម្រង់របបគ្រប់គ្រងរដ្ឋ ដោយយកអភិបាលកិច្ចជាស្នូល ពេលគឺ ឆ្នាំ២០០៤ "យុទ្ធសាស្ត្រចតុកោណ" ដំណាក់កាលទី១ ដើម្បីកំណើនការងារ សមធម៌ និងប្រសិទ្ធភាពនៅកម្ពុជាសម្រាប់នីតិកាលទី៣នៃរដ្ឋសភា និង ឆ្នាំ២០១៣ "យុទ្ធសាស្ត្រចតុកោណ" របស់រាជរដ្ឋាភិបាល ដំណាក់កាលទី៣ នីតិកាលទី៤នៃ រដ្ឋសភាបានយក "អភិបាលកិច្ចល្អ" ជាធាតុស្នូលនិងជាបន្ទាត់នយោបាយក្នុងការគ្រប់គ្រង និងដឹកនាំរាជរដ្ឋាភិបាល។ ម្យ៉ាងទៀត យុទ្ធសាស្ត្រចតុកោណរបស់រដ្ឋាភិបាល ដំណាក់កាល ទី៤ "អភិបាលកិច្ច" នៅតែជាចំណុចអាទិភាព។ ដើម្បីឱ្យកម្មវិធី អភិបាលកិច្ចល្អនេះអាច ដំណើរការទៅបាន លុះត្រាតែមានការចូលរួមពីគូអង្គសំខាន់ៗគឺ៖ (១) ស្ថាប័នរដ្ឋ (ស្ថាប័ន នយោបាយ និងរដ្ឋបាល) (២) វិស័យឯកជន និង (៣) សង្គមស៊ីវិល (ក្រសួងមហាផ្ទៃ, ឆ្នាំ២០១៣)។

ដើម្បីឆ្លើយតបទៅនឹងយុទ្ធសាស្ត្រនេះ៖   អង្គភាពនីមួយៗចាំបាច់ត្រូវពង្រឹងការគ្រប់គ្រង
ធនធានមនុស្ស ដែលមានសមត្ថភាពឱ្យមានប្រសិទ្ធភាពនិងប្រកបដោយចីរភាព។ ធនធាន
មនុស្សប្រកបដោយសមត្ថភាពកំពុងដើរតួនាទីសំខាន់ក្នុងអង្គភាពនិរន្តភាព ដោយមានការរួម
ចំណែកជាទូទៅ។ ការពិចារម្រើននៃអភិបាលកិច្ចល្អក៏មានសារៈសំខាន់ផងដែរសម្រាប់និរន្តរភាព
នៃអង្គភាព។ ប្រសិនបើការគ្រប់គ្រងធនធានមនុស្សមានតួនាទីសំខាន់ចំពោះនិរន្តរភាពរបស់
អង្គភាព ការស្វែងរកព័ត៌មានអង្គភាព និងការពិនិត្យឡើងវិញអំពីរបៀបដែលធនធានមនុស្ស
អាចរួមចំណែកដល់ការបង្កើតឱ្យមានអភិបាលកិច្ចល្អក្នុងអង្គភាពមួយប្រាកដជាអាចធ្វើទៅបាន។
គោលគំនិតនៃអភិបាលកិច្ចល្អបង្ហាញពីគោលគំនិត   និងទំនាក់ទំនងរវាងអភិបាលកិច្ចនិង
ធនធានមនុស្សនៅក្នុងរដ្ឋជីវៈគ្រប់គ្រងអង្គភាពបច្ចុប្បន្ន។ ឆ្នាំ២០១៨ យុទ្ធសាស្ត្រចតុកោណ
ដំណាក់កាលទី៤ របស់រាជរដ្ឋាភិបាល នីតិកាលទី៦នៃរដ្ឋសភា បន្តការកែទម្រង់អភិបាលកិច្ច
ដែលជាស្នូលក្នុងការធ្វើកំណែទម្រង់   ដោយបង្កើនល្បឿននៃកំណែទម្រង់អភិបាលកិច្ចល្អ
(រាជរដ្ឋាភិបាលកម្ពុជា, ២០១៨)។

តាមការស្រាវជ្រាវ "តម្លាភាព" មានន័យថា ការសម្រេចចិត្តត្រូវបានអនុវត្តឱ្យឆ្លើយទៅនឹង
ការស្នើសុំក្នុងក្របខណ្ឌច្បាប់។   គោលការតម្លាភាពត្រូវផ្តល់នូវសិទ្ធទទួលបានព័ត៌មានដោយ
សេរីនិងយុត្តិធម៌ ទទួលបានការចូលរួមសម្រេចចិត្តដោយផ្ទាល់ ឬដោយប្រយោលក្នុងអង្គភាព។
គោលនយោបាយតម្លាភាពក្នុងការគ្រប់គ្រងគឺៈ (១) បង្ហាញពីកាពស្មោះត្រង់ចំពោះអង្គភាព
គោលនយោបាយផ្សេងៗបូរវរបស់អង្គភាពសម្រាប់រយៈពេលវែង ធ្វើឱ្យគោលនយោបាយនិង
លទ្ធផលមានភាពស៊ីសង្វាក់គ្នាសម្រាប់អង្គភាព   និងគោលនយោបាយផ្តល់តម្លៃដល់នយោជិត
(២) គោរពសិទ្ធិនិងស្វ័យភាពរបស់អង្គភាព ផ្តល់សេរីភាពនៃការទទួលព័ត៌មានដល់គ្រប់ភាគី
៣ក់ព័ន្ធ ផ្តល់ការសម្រេចចិត្តដល់នយោជិតគ្រប់ទីកន្លែងដែលពួកគេនៅ មានភាពស៊ីសង្វាក់
គ្នារវាងថ្នាក់លើនិងថ្នាក់ក្រោម (Arulrajah, 2016)។

តាមការស្ទង់មតិដោយពិនិត្យរកមើលតម្លាភាពតាមរយៈការប្រើប្រាស់ថវិការបស់ធនាគារ
ពិភពលោកនៅក្នុងបណ្ដាប្រទេសអឺរ៉ុបភាគខាងកើត   យន្តការដែលគេបានប្រើដើម្បីពិនិត្យរក
តម្លាភាពក្នុងការប្រើប្រាស់ថវិកានោះគឺៈ (១) ពិភាក្សាអំពីថវិកាដែលបានគ្រោងទុកជាមួយ
អង្គការសង្គមស៊ីវិល (២) រៀបចំវេទិកាថវិកាសាធារណៈ៖ (៣) ផ្សព្វផ្សាយសេចក្តីព្រាងថវិកា
មុនពេលក្រុមប្រឹក្សាក្រុងបានបោះឆ្នោតសម្រេច (៤) បង្កើតប្រព័ន្ធព័ត៌មានថវិកាក្នុងអង្គភាព/

គំបន់ (៥) បង្កើតវេទិកាសាធារណៈកញ្ចប់ចំវិការបស់រដ្ឋាបាល និង (៦) បង្ហាញកញ្ចប់ ចំវិកាដែលបានអនុម័តធ្លៀបនឹងឆ្នាំចាស់ (Kownley, 2006)។ តាមទ្រឹស្តីបទ្រចុះផ្សាយស្តីពី រដ្ឋាភិបាលបើកចំហ សមាសភាគដែលនាំឱ្យមានតម្លាភាពចំវិកាមានបីធំៗគឺ៖ (១) ការបង្កើត ប្រព័ន្ធព័ត៌មាននិងចេញផ្សាយឱ្យទាន់ពេលវេលា (២) ប្រសិទ្ធភាពតាមផ្លូវច្បាប់ និង (៣) ប្រសិទ្ធភាពសង្គមសុីវិលតាមរយៈការផ្តល់សេវាសាធារណៈ (Wirtz and Birkmeyer, 2015)។

ដោយឡែក បញ្ញត្តិតម្លាភាព ទាំងប្រទេសកំពុងអភិវឌ្ឍ ទាំងប្រទេសអភិវឌ្ឍហើយ ចាំបាច់ ត្រូវមាន៖ (១) ការចូលរួម (២) ធនធាន (៣) ភាពជាអ្នកដឹកនាំ (៤) ការបណ្តុះបណ្តាល (៥) វប្បធម៌ការិយាធិបតេយ្យ និង (៦) រដ្ឋបាលសមត្ថភាព (Eccleston & Stubbs, 2016)។ តាមទ្រឹស្តីបំត្រ Popular Financial Reports as Fiscal Transparency Mechanisms របៀបធ្វើឱ្យមានតម្លាភាពក្នុងរបាយការណ៍ហិរញ្ញវត្ថុពន្ធដារដើម្បីបង្កើត អភិបាលកិច្ចល្អគឺ៖ (១) ធ្វើបច្ចុប្បន្នភាពព័ត៌មាន (២) កំណត់ស្តង់ដារនិងពន្យល់ពីលំហូរ របាយការណ៍ហិរញ្ញវត្ថុនោះ (៣) របាយការណ៍ហិរញ្ញត្រូវផ្តល់ឱ្យដល់អ្នកអានជាសាធារណៈ៖ (៤) បច្ចុប្បន្នភាពទិន្នន័យនិងប្រៀបធៀប (៥) របាការណ៍ហិរញ្ញវត្ថុត្រូវតែសាមញ្ញនិង ទាក់ទាញ និង(៦) ផ្សព្វផ្សាយឱ្យដល់អតិថិជនគោលដៅ (Jordan et al., 2016)។

ឆ្នាំ២០០៤ ˝តម្លាភាព˝ ត្រូវបានរាជរដ្ឋាភិបាលនៃព្រះរាជាណាចក្រកម្ពុជាយកធ្វើជាសូចនាករ មួយ ក្នុងកំណែទម្រង់ប្រព័ន្ធហិរញ្ញវត្ថុសាធារណៈ។ សូចនាករនេះ (តម្លាភាព) ត្រូវបាន កំណត់ក្នុងកំណែទម្រង់ប្រព័ន្ធហិរញ្ញវត្ថុសាធារណៈថា៖ ˝តម្លាភាព˝ សំដៅដល់វាល់ច្បាប់ បទប្បញ្ញត្តិ គោលការណ៍ នីតិវិធី និងការអនុវត្តទាំងឡាយ ដែលត្រូវផ្សព្វផ្សាយឱ្យទូលាយ សម្រាប់ក្រសួង ស្ថាប័ន ឬអង្គភាពសាធារណៈ និងសាធារណៈជន˝ (ក្រសួងសេដ្ឋកិច្ច និង ហិរញ្ញវត្ថុ, ២០១៣, ទំ.៤៥)។

ដោយឡែកតាមការស្រាវជ្រាវ ˝គណនេយ្យភាព˝ គឺជាការសម្រេចចិត្តនិងទទួលខុសត្រូវ គ្រប់សកម្មភាពអង្គភាពប្រកបដោយតម្លាភាព និងស្របតាមនីតិរដ្ឋ។ គោលនយោបាយ គណនេយ្យត្រូវធ្វើឡើងចំពោះភាគីទាក់ទិន និយោជិត សហជីក និងសង្គមសុីវិល ព្រមទាំង កម្លាំងពលកម្មផងដែរ។ សីលធម៌ សុវត្ថិភាព សុខភាព និងសុខមាលភាពរបស់ពួកគេត្រូវ បានការពារចំពោះមុខច្បាប់ និងស្របតាមនីតិរដ្ឋ (Arulrajah, 2016)។ ˝គណនេយ្យភាព˝

គឺជាគោលនយោបាយគន្លឹះរបស់រដ្ឋាភិបាលប្រជាធិបតេយ្យ និងជាស្នូលនៃគោលនយោបាយ អភិបាលកិច្ចល្អរបស់ខ្លួន។ គណនេយ្យភាពបង្ហាញពី៖ (១) ការទទួលខុសត្រូវរបស់អង្គភាព (២) កាត់បន្ថយអំពើពុករលួយក្នុងអង្គភាព/រដ្ឋាភិបាល (៣) ពន្លឿនផ្តែកសេវាសាធារណៈ (៤) ភាពត្រឹមត្រូវនៃមូលដ្ឋានគតិយុត្តិនិងច្បាប់ (Wirtz and Birkmeyer, 2015)។

ម្យ៉ាងទៀត "គណនេយ្យភាព" ជាសមាសភាពនៃអភិបាលកិច្ច គឺ៖ (១) "គណនេយ្យ ភាព" ជាគុណធម៌ (Accountability as a Virtue) ដែលផ្តល់ភាពស្របច្បាប់ទៅមន្ត្រី សាធារណៈ និងអង្គភាពសាធារណៈ ដែលរួមមានតម្លាភាព ភាពជឿទុកចិត្ត សមត្ថភាព ចាត់ចែង ទំនួលខុសត្រូវ និងភាពឆ្លើយតបទាន់ពេល និង (២) គណនេយ្យភាពជាយន្តការ ដែលមានន័យថា ប្រព័ន្ធគណនីត្រូវឆ្លើយទៅនឹងសំណួរពីរជាមូលដ្ឋានគឺ៖ តើនរណាជាគូអង្គ បង្ហាញគណនី? និងហេតុអ្វីត្រូវតែបង្កើតគណនី? គណនេយ្យភាពជាយន្តការនៃការសម្រេចចិត្ត របស់អង្គភាព/រដ្ឋាភិបាលក្នុងការបង្កើតឱ្យមានអភិបាលកិច្ចល្អ មាននិន្ទាការធានាឱ្យមាន គណនេយ្យភាពដល់សាធារណជននិងអង្គភាពសាធារណៈប្រកបដោយគុណធម៌ (Bovens, 2010)។

យោងតាមការសិក្សាផ្តែករដ្ឋបាលសាធារណៈ ឧបករណ៍ធំៗចំនួនប្រាំត្រូវបានប្រើក្នុង ការវាស់គណនេយ្យភាពគឺ៖ (១) តម្លាភាព តើយន្តការក្នុងអង្គភាពបង្ហាញជាសាធារណៈ ឬទេ? (២) ភាពជឿទុកចិត្ត តើយន្តការអង្គភាពមានឧបសគ្គដែរឬទេ? (៣) សមត្ថភាព គ្រប់គ្រង តើអង្គភាពបានដំណើរការតាមគោលនយោបាយ និងនីតិវិធីឬទេ? (៤) ទំនួលខុស ត្រូវ តើអង្គភាពអនុវត្តតាមច្បាប់ឬទេ? (៥) ភាពឆ្លើយតបទាន់ពេល តើអង្គភាពសម្រេច បានតាមគោលដៅឬទេ? (Christie, 2017)។ ដូចគ្នាដែរ ឆ្នាំ២០០៤ "គណនេយ្យភាព" ត្រូវបានរាជរដ្ឋាភិបាលនៃព្រះរាជាណាចក្រកម្ពុជា យកធ្វើជាសូចនាករមួយទៀតក្នុងកំណែ ទម្រង់ប្រព័ន្ធហិរញ្ញវត្ថុសាធារណៈ។ សូចនាករនេះ (គណនេយ្យភាព) ត្រូវបានកំណត់ក្នុង កំណែទម្រង់ប្រព័ន្ធហិរញ្ញវត្ថុសាធារណៈយ៉ាងដូច្នេះថា "គណនេយ្យភាព សំដៅលើការទទួល ខុសត្រូវរបស់ក្រសួង ស្ថាប័ន ឬអង្គភាពសាធារណៈប្រហាក់ប្រហែល រដ្ឋបាលថ្នាក់ក្រោមជាតិ និងបុគ្គលចំពោះមុខងារ និងការកិច្ចដែលទទួលអនុវត្តតាមរយៈប្រព័ន្ធបាយការណ៍" (ក្រសួងសេដ្ឋកិច្ច និងហិរញ្ញវត្ថុ, ២០១៣, ទំ. ៤៥)។

ឆ្នាំ២០០៨នេះដែរ រាជរដ្ឋាភិបាលចាប់ផ្តើមអនុវត្តកម្មវិធីកំណែទម្រង់ការគ្រប់គ្រងហិរញ្ញវត្ថុ
សាធារណៈដែលមាន ៤ដំណាក់កាល ហើយការបង្កើតគណនេយ្យហិរញ្ញវត្ថុជាដំណាក់កាលទី២
និងការបង្កើតគណនេយ្យភាពចំពោះសមិទ្ធកម្មជាដំណាក់កាលទី៤ (ក្រសួងសេដ្ឋកិច្ច និង
ហិរញ្ញវត្ថុ, ២០១៥)។

ចំណែក "ភាគីពាក់ព័ន្ធ" តាមការសិក្សាស្រាវជ្រាវសំដៅដល់ការចូលរួមដោយផ្ទាល់ ឬតាម
រយៈស្ថាប័នអន្តរការីច្បាប់ ឬតាមរយៈតំណាងដែលរកផលប្រយោជន៍រួមជូនអង្គភាព មិនមែន
រកផលប្រយោជន៍ជូនបុគ្គលទេ។ ការពិចារណា ការសម្រេចចិត្ត ឬការចូលរួមត្រូវមានការជូន
ដំណឹង និងរៀបចំជាមុន។ ដំណើរការចូលរួមនេះជាការចូលរួមដោយសេរីភាព និងមានសេរីភាព
ក្នុងការបញ្ចេញមតិ ព្រមទាំងសេរីភាពនៃការចូលរួមពីសង្គមស៊ីវិល (Arulrajah, 2016)។
វិឯ្គ្រឹត្តិបត្រចុះផ្សាយអន្តរជាតិស្តីពីរដ្ឋាភិបាលបើកចំហ (Open Government: Origin,
Development, and Conceptual Perspectives) យើងឃើងដកស្រង់បានមូលដ្ឋានបួនធំៗក្នុង
ការចូលរួមគឺ៖ (១) ផ្តល់ការលើកទឹកចិត្ត (២) ផ្តល់ឱកាសស្មើៗគ្នា (៣) ផ្តល់សេរីភាពក្នុង
ការសម្រេចចិត្តដោយផ្ទាល់និងដោយប្រយោល និង (៤) ផ្តល់សេរីភាពក្នុងការបញ្ចេញមតិ
ជាសាធារណៈ (Wirtz & Birkmeyer, 2015)។ ចំពោះរដ្ឋាភិបាលបើកចំហ ការចូលរួម
របស់ពលរដ្ឋជាសមាសធាតុសំខាន់ទី៣៖ ពោលគឺការបង្កើតជាយន្តការ និងវិធីសាស្ត្រនៃការ
ចូលរួមរបស់ពលរដ្ឋក្នុងការសម្រេចចិត្តជាសាធារណៈ (Duțu1 & Diaconu, 2017)។

ម្យ៉ាងទៀត តាមចក្ខុវិស័យរបស់ OECD (Organisation for Economic) ការចូលរួម
របស់ប្រជាពលរដ្ឋក្នុងរដ្ឋាភិបាលជាសាធារណៈត្រូវមានសមាសភាពបីគឺ៖ (១) ការទទួល
បានព័ត៌មានគ្រប់គ្រាន់របស់ពលរដ្ឋ (២) ការពិគ្រោះយោបល់ត្រូវធ្វើឡើងតាមមធ្យោបាយ
ទ្វេភាគីរវាងប្រជាពលរដ្ឋ និងរដ្ឋាភិបាល និង (៣) ការបង្កើតភាពជាដៃគូរវាងប្រជាពលរដ្ឋ
និងរដ្ឋាភិបាល (Duțu1 & Diaconu, 2017)។ ម្យ៉ាងទៀតការចូលរួមអាចមានច្រើនរូបភាព
ដូចជា (១) ការចូលរួមជាមតិយោបល់ (២) ការចូលរួមតាមបណ្ដាញផ្សេងៗដូចជាទូរសព្ទ
អ៊ីម៉ែលជាដើម (៣) ការជួបប្រជុំដោយផ្ទាល់ និង (៤) ការចូលរួមក្នុងវេទិកាសាធារណៈ
ជាដើម (Cooley, 2010)។

រូបភាពទី១. ខ្នាតរង្វាស់តម្លាភាព គណនេយ្យភាព និងភាគីពាក់ព័ន្ធសម្រាប់ការស្រាវជ្រាវ
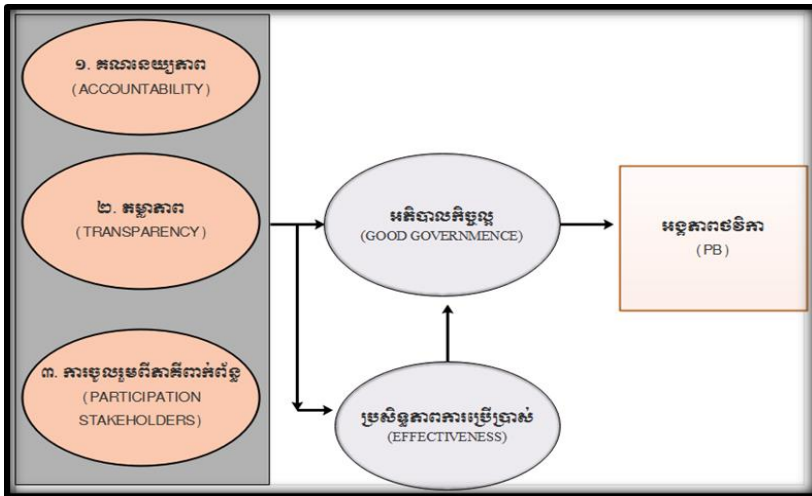
(កែសម្រួលពីធនាគារពិភពលោក, 2010)

ការចូលរួមដោយប្រយោលគឺ ការចូលរួមតាមប្រព័ន្ធផ្សព្វផ្សាយបណ្តាញសង្គមនានាដូចជា ទូរសព្ទ អ៊ីម៉ែលជាដើមត្រូវបានស្ទើឡើងដោយឧបករណ៍ចំនួនប្រាំគឺៈ (១) ការលើកស្ទួយ ប្រព័ន្ធព័ត៌មាន (២) ការលើកស្ទួយស៊ុយត្រួតពិនិត្យ (self-discovery motive) (៣) ការ លើកស្ទួយសមាហរណកម្មសង្គម (social integration motive) (៤) ការលើកស្ទួយការ បង្កើនអត្តប្រយោជន៍សង្គម (social enhancement motive) (៥) ការលើកស្ទួយការ កំសាន្ត (Cooley, 2010)។ ទន្ទឹមនឹងនេះដែរ គោលនយោបាយអភិបាលកិច្ចល្អត្រូវបាន រាជរដ្ឋាភិបាលលើកទឹកចិត្តឱ្យភាគីពាក់ព័ន្ធគ្រប់អង្គភាពសាធារណៈ ពិសេស ភាគីពាក់ព័ន្ធ នឹងគ្រឹះស្ថានឧត្តមសិក្សាសាធារណៈដែលរួមមាន៤ផ្នែកគឺៈ (១) ក្រុមប្រឹក្សាភិបាល (២) ឧត្តមសិក្សា (៣) ឧស្សាហកម្មនិង(៤) ដៃគូអភិវឌ្ឍន៍ផ្នែកអប់រំ។ រាជរដ្ឋាភិបាលជាអ្នក បង្កើតគោលនយោបាយ ផ្តល់សេវាកម្មដែលមានវិជ្ជាជីវៈ សម្របសម្រួល និងជានិយ័តករ យ៉ាងទូលំទូលាយក្នុងវិស័យអប់រំនៅកម្ពុជា។ រាជរដ្ឋាភិបាលតាមរយៈក្រសួងអប់រំ យុវជន និងកីឡា និងតាមរយៈនាយកដ្ឋានឧត្តមសិក្សា ជាអ្នកបង្កើតគោលនយោបាយ ដោយត្រូវ សម្របសម្រួលជាមួយក្រសួងដៃទៃក្នុងការបង្កើតគោលនយោបាយធនធានមនុស្ស (Sam & Dhles, 2015)។ យោងតាមការសិក្សាខាងលើ យើងអាចបង្កើតខ្នាតរង្វាស់តម្លាភាព

គណនេយ្យភាព និងភាគីពាក់ព័ន្ធសម្រាប់ការស្រាវជ្រាវ ដោយផ្អែកលើទ្រឹស្ដីអភិបាលកិច្ចដូច
ខាងក្រោមនេះ (រូបភាពទី១)។

ម្យ៉ាងទៀត តាមគំរូការវិយាធិបតេយ្យដែលបានបញ្ចូលទុកនៅក្នុងរដ្ឋបាលអប់រំតាម
គ្រឹះស្ថានឧត្តមសិក្សាសាធារណៈនានានៅកម្ពុជា ភាគីពាក់ព័ន្ធក្នុងការសម្រេចចិត្តនានាត្រូវ
ផ្សារភ្ជាប់ជិតស្និតជាមួយស្ថាប័នរាជរដ្ឋាភិបាល (Sam & Dhles, 2015)។ ជាក់ស្ដែង ក្នុង
រយៈពេលប៉ុន្មានឆ្នាំចុងក្រោយនេះ រាជរដ្ឋាភិបាលបានផ្ដួចផ្ដើមអនុវត្តគោលនយោបាយ
អភិបាលកិច្ចល្អ និងគោលនយោបាយហិញ្ញប្បទាន ដើម្បីបន្ធុរការពឹងផ្អែកលើជំនួយផ្នែក
អប់រំ។ សាកលវិទ្យាល័យទាំងគ្រឹះស្ថានឧត្តមសិក្សាសាធារណៈ និងទាំងសាកលវិទ្យាល័យ
ឯកជនត្រូវធ្វើការតាមដានដោយគណៈកម្មការទទួលស្គាល់គុណភាពអប់រំនៃកម្ពុជា (ACC)
ចាប់ពីឆ្នាំ២០០៣មក (Sam & Dhles, 2015)។ នាយកដ្ឋានឧត្តមសិក្សាដើរតួជាអ្នក
សម្របសម្រួលក្នុងការរៀបចំគោលនយោបាយអប់រំ កំណត់ទម្រង់កម្មវិធីសិក្សា។ ដៃគូអភិវឌ្ឍន៍
រួមទាំងម្ចាស់ជំនួយទ្វេភាគីអន្តរជាតិ ភ្នាក់ងារនិងម្ចាស់ជំនួយពហុភាគីដូចជា ភ្នាក់ងារអភិវឌ្ឍន៍
នៃអង្គការសហប្រជាជាតិ ធនាគារពិភពលោក ធនាគារអភិវឌ្ឍន៍អាស៊ី និងហ្គាតពអឺរ៉ុបជាដើម
(Sam & Dhles, 2015)។

វិធីសាស្ត្រស្រាវជ្រាវ

គ្រឹះស្ថានឧត្តមសិក្សាសាធារណៈមួយត្រូវបានជ្រើសរើសជាតំបន់គោលដៅក្នុងការស្រាវជ្រាវ
លើប្រធានបទ "ខ្វាតរង្វាស់តម្លាភាព គណនេយ្យភាព និងភាគីពាក់ព័ន្ធក្នុងការប្រើប្រាស់បវិក
កម្មវិធី (PB) នៅគ្រឹះស្ថានឧត្តមសិក្សាសាធារណៈមួយក្នុងព្រះរាជាណាចក្រកម្ពុជាដោយផ្អែក
លើទ្រឹស្ដីអភិបាលកិច្ចល្អ"។ អ្នកចូលរួមធ្វើយកម្រងសំណួរមានចំនួន ១០៦នាក់ មកពីគ្រប់
មហាវិទ្យាល័យ វិទ្យាស្ថាន និងបណ្ណាល័យនៃសាកលវិទ្យាល័យ។

ការប្រមូលទិន្នន័យ

ទិន្នន័យដែលត្រូវប្រមូលមានពីរប្រភេទគឺទិន្នន័យបន្ទាប់បន្សំ និងទិន្នន័យដើម។ ទិន្នន័យ
បន្ទាប់បន្សំត្រូវបានប្រមូលពីក្រសួងអប់រំ យុវជន និង កីឡា (EMIS) អង្គការជាតិ អង្គការ
អន្តរជាតិ (ធនាគារពិភពលោក & ធនាគារអភិវឌ្ឍអាស៊ី) និងអត្ថបទក្នុងទស្សនាវដ្ដីស្រាវជ្រាវ
ដើម្បីយកជាមូលដ្ឋានរ៉ាំលើកទ្រឹស្ដីពាក់ព័ន្ធ និងជាមូលដ្ឋានផ្ទៀងផ្ទាត់នឹងទិន្នន័យដើមដែល
ប្រមូលបាន។

ការប្រមូលទិន្នន័យដើម៖ កម្រងសំណួរផ្លូវការ (Structured Questionnaires) ត្រូវ
បានបង្កើតដោយមានសំណួរបិទ និងសំណួរបើក ដើម្បីប្រមូលទិន្នន័យបែបបរិមាណវិស័យ
ទាក់ទងនឹងអភិបាលកិច្ចហិរញ្ញវត្ថុ ដែលអនុវត្តដោយគណៈគ្រប់គ្រង មហាវិទ្យាល័យ ដេប៉ាតឺម៉ង់
និងការិយាល័យនីមួយៗ។ ការប្រមូលទិន្នន័យបរិមាណវិស័យនេះអាចឱ្យឃើងវិភាគបែបស្ថិតិ
ដែលមានសារសំខាន់សម្រាប់អ្នកធ្វើផែនការ និងអ្នកធ្វើគោលនយោបាយ។ បន្ទាប់មក កម្រង
សំណួរត្រូវបានចែកជូនអ្នកចូលរួមឆ្លើយសំណួរបំពេញដោយខ្លួនឯង។ ការប្រើជើសាស្ត្របែបនេះ
អាចឱ្យអ្នកចូលរួមឆ្លើយសំណួរបានបញ្ចេញយោបល់ដោយសេរីជាលក្ខណៈអាណាមឹក។

ការវិភាគទិន្នន័យ

ក្នុងការសិក្សានេះ ស្យេបានប្រើជើសាស្ត្រវិភាគបែបបរិមាណវិស័យ និងបែបគុណវិស័យ។
ការវិភាគទិន្នន័យបែបគុណវិស័យគឺវិភាគតាមចំណងជើងនិងតាមបញ្ហា។ ស្យេធ្វើការវិភាគ
ដោយផ្អែកលើទិន្នន័យបន្ទាប់បន្សំ និងឯកសារស្រាវជ្រាវដែលមានស្រាប់។ ការវិភាគនេះជួយ
ឱ្យឃើងយកទិន្នន័យដែលមានស្រាប់ ក៏ដូចជាទិន្នន័យបន្ទាប់បន្សំ មកផ្ទៀងផ្ទាត់ជាមួយ
ទិន្នន័យដើម ដែលបានមកពីការអង្កេត។ ការវិភាគរកបញ្ហាក់អាចជួយឱ្យឃើងដឹងពីប្ញសគល់
និងប្រកពនៃបញ្ហាដែលជួបប្រទះដោយគ្រឹះស្ថានឧត្តមសិក្សាសាធារណៈនៅកម្ពុជាដែរ។

ចំពោះការវិភាគទិន្នន័យបែបបរិមាណវិស័យវិញ ស្យេបានប្រើទាំងការវិភាគបែបស្ថិតិ និង
ពណ៌នាបែបស្ថិតិ (Descriptive Statistic Analysis) ដែលអាចរកឃើញភាពញឹកញាប់
(Frequency) និងភាគរយទាក់ទងនឹងសូចនាករមួយចំនួនដូចជាប្រភេទភ្ទនាទី ប្រភេទនៃ
ការចំណាយ ប្រភេទចំណូល និងប្រកពថវិកាជាដើម។ ចំណែកការវិភាគទស្សនៈ និងភាព
ពេញចិត្តលើអភិបាលកិច្ច គណនេយ្យភាព តម្លាភាព និងការចូលរួមក្នុងការគ្រប់គ្រងថវិក
កម្មវិធីនៅតាមគ្រឹះស្ថានឧត្តមសិក្សាសាធារណៈត្រូវបានវាស់ស្ទង់ជា ៥កម្រិត គឺ៖ ខ្ពស់ណាស់
ខ្ពស់ មធ្យម ទាប និងទាបណាស់។

លទ្ធផលស្រាវជ្រាវ

តាមការស្រាវជ្រាវនិងវិភាគដោយប្រើឧបករណ៍វិភាគខាងលើ របកគំឃើញនៃខ្នាតរង្វាស់
ពីតម្លាភាព និងគណនេយ្យភាពនៃការប្រើប្រាស់ថវិកាកម្មវិធី ដោយផ្អែកលើទ្រីស្ទីអភិបាល
កិច្ច ត្រូវបានបង្ហាញក្នុងតារាងទី១ និងរង្វាស់ពីភាគីពាក់ព័ន្ធត្រូវបានបង្ហាញក្នុងតារាងទី២។

ខ្នាតរង្វាស់តម្លាភាពនិងគណនេយ្យភាពដោយផ្អែកលើទ្រីស្ទីអភិបាលកិច្ចល្អ

តារាងទី១ខាងក្រោមនេះបង្ហាញពីខ្នាតរង្វាស់តម្លៃភាពនិងគុណនេយ្យភាពនៃការប្រើប្រាស់ ចរិកកម្មវិធី (PB) គ្រឹះស្ថានឧត្តមសិក្សាសាធារណៈមួយ។ សូចនាករសរុប ចំនួន២២ ត្រូវ បានប្រើជាខ្នាតរង្វាស់នេះ។ ការវិភាគបានបង្ហាញថា តម្លៃភាពនៃការប្រើប្រាស់ចរិកកម្មវិធី នៅអង្គភាព សាមីនៅមានកម្រិតនៅថ្លើយ ព្រោះតម្លៃ M (២.៧៧) បង្ហាញលើសពីseptember ពាក់ កណ្ដាល សម្តែងការមិនពេញចិត្តចំពោះសមាសភាពទាំងពីរនេះ (តម្លៃភាពនិងគុណនេយ្យភាព) ដែលតម្រូវឱ្យអង្គភាពចរិកបញ្ចេញនូវរាល់ព័ត៌មានហិរញ្ញវត្ថុ និងគុណនេយ្យចាំបាច់ឱ្យដល់ មន្ត្រីក្រោមឱវាទដឹងដោយគ្មានការលាក់បាំង។ ម្យ៉ាងទៀត គ្រប់ប្រតិបត្តិការណ៍ចំណូល- ចំណាយរបស់អង្គភាពចរិកសាមី គួរត្រូវបានបង្ហាញដល់មន្ត្រីក្រោមឱវាទយ៉ាងហោចណាស់ ត្រឹមគណៈគ្រប់គ្រងថ្នាក់កណ្ដាលដែរ។ ម្យ៉ាងទៀត ការរៀបរៀងបតម្លៃ M និងមធ្យមភាគជា ភាគរយបានបង្ហាញថា ភាពពេញចិត្ត និងភាពពេញចិត្តទាំងស្រុងមានត្រឹមតែ ៤០.៩៧% ប៉ុណ្ណោះ។ លទ្ធផលក្រោម ៥០% នេះបង្ហាញពីការមិនសប្បាយចិត្តរបស់ពួកគាត់ ព្រោះ លទ្ធផលដែលបានពីតម្លៃខ្នាតរង្វាស់ ក៏ដូចជាការរៀបរាប់ពីការប្រើប្រាស់ចរិកកម្មវិធីទាំងទ្រង នឹងគោលការណ៍តម្លៃភាព និងគុណនេយ្យភាពនៅអង្គភាពចរិកសាមី នៅមានកម្រិតនៅថ្លើយ។ ជាគោលការណ៍ អង្គភាពចរិកសាមីគួរកាត់បន្ថយនូវការលាក់បាំងព័ត៌មានហិរញ្ញវត្ថុ និង គុណនេយ្យចាំបាច់ ហើយបង្កើននូវការផ្សាយពីលំហូរប្រតិបត្តិការណ៍ហិរញ្ញវត្ថុ និងគុណនេយ្យ ឱ្យធ្លើយតបតាមការចង់បាន។

ខ្នាតរង្វាស់ពីភាគីពាក់ព័ន្ធដោយផ្អែកលើទ្រឹស្តីអភិបាលកិច្ចល្អ

តារាងទី២ខាងក្រោមនេះបង្ហាញអំពីខ្នាតរង្វាស់ភាគីពាក់ព័ន្ធនៃការប្រើប្រាស់ចរិកកម្មវិធី (PB) គ្រឹះស្ថានឧត្តមសិក្សាសាធារណៈនោះ។ សូចនាករសរុប ចំនួន៩ ត្រូវបានប្រើជាខ្នាត សម្រាប់វាស់ភាគីពាក់ព័ន្ធ។ លទ្ធផលនៃការវិភាគបង្ហាញថា អ្នកធ្លើយសំណួរច្រើនជាង ៥០% សម្តែងការមិនពេញចិត្តចំពោះសមាសភាពមួយនេះ (ភាគីពាក់ព័ន្ធ) ព្រោះតម្លៃ M (២.៧៨) បង្ហាញថា ភាគីពាក់ព័ន្ធមិនត្រូវបានអនុញ្ញាតិឱ្យចូលរួមពេញលេញក្នុងការសម្រេចចិត្តនានា ទាក់ទងនឹងចរិកកម្មវិធីទេ ហើយការសម្រេចចិត្តទាក់ទងនឹងចរិកកម្មវិធីនេះបន្តធ្វើឡើងជា កញ្ចប់ចរិករដ្ឋបាល។ ម្យ៉ាងទៀត លទ្ធផលនៃការវិភាគដែលបង្ហាញខ្នាតរង្វាស់ក្រោម ៥០% (៤៣.៨៣%) បង្ហាញភាពមិនពេញចិត្ត និងភាពមិនពេញចិត្តទាំងស្រុង ព្រោះការសម្រេច

ចិត្តទាំងឡាយទាក់ទងនឹងថវិកាកម្មវិធីដោយគ្មានវត្តមានរបស់ពួកគាត់ ឬការមិនផ្ដល់ការ សម្រេចចិត្តពេញលេញដល់ពួកគាត់។

ការពិនិត្យក្សា

ទ្រឹស្ដីរបស់លោក Downley ឆ្នាំ២០០៦ បានលើកឡើងថា ដើម្បីឱ្យការគ្រប់គ្រងថវិកា មានអភិបាលកិច្ចល្អ ការប្រើប្រាស់ថវិកាត្រូវមានដោយយន្តការ ហើយយន្តការដែលបានដាក់ ចេញក្នុងការរកមើលតម្លាភាពក្នុងការប្រើប្រាស់ថវិកានោះគឺៈ (១) ពិភាក្សាអំពីថវិកាដែល បានគ្រោងទុកជាមួយអង្គការសង្គមស៊ីវិល (២) រៀបចំវេទិកាថវិកាសាធារណៈ (៣) ផ្សព្វផ្សាយ សេចក្ដីព្រាងថវិកាមុនពេលក្រុមប្រឹក្សាក្រុងបានបោះឆ្នោតសម្រេច (៤) បង្កើតប្រព័ន្ធព័ត៌មាន ថវិកាក្នុងអង្គភាព/តំបន់ (៥) បង្កើតវេទិការសាធារណៈកញ្ចប់ថវិការបស់រដ្ឋាបាល និង (៦) បង្ហាញកញ្ចប់ថវិកាដែលបានអនុម័តធៀបនឹងឆ្នាំចាស់។ ម្យ៉ាងទៀត តាមព្រឹត្តិបត្រ របស់ លោក Wirtz and Birkmeyer ឆ្នាំ២០១៥ ស្ដីពីរដ្ឋាភិបាលបើកចំហ សមាសភាគ ដែលនាំឱ្យមានតម្លាភាពថវិកាមានបីធំៗគឺៈ (១) ការបង្កើតប្រព័ន្ធព័ត៌មាននិងចេញផ្សាយ ឱ្យទាន់ពេលវេលា (២) ប្រសិទ្ធភាពតាមផ្លូវច្បាប់ និង (៣) ប្រសិទ្ធភាពសង្គមស៊ីវិលតាម រយៈការផ្ដល់សេវាសាធារណៈ។

ម្យ៉ាងទៀត លោក Wirtz and Birkmeyer ឆ្នាំ២០១៥ "គណនេយ្យភាព" គឺជា គោលនយោបាយគន្លឹះរបស់រដ្ឋាភិបាលប្រជាធិបតេយ្យ និងជាស្នូលនៃគោលនយោបាយ អភិបាលកិច្ចល្អរបស់ខ្លួន។ គណនេយ្យភាពបង្ហាញពីៈ (១) ការទទួលខុសត្រូវរបស់អង្គភាព (២) ការកាត់បន្ថយអំពើពុករលួយក្នុងអង្គភាព/រដ្ឋាភិបាល (៣) ការពន្លឿនផ្នែកសេវា សាធារណៈ (៤) ភាពត្រឹមត្រូវនៃមូលដ្ឋានគតិយុត្តិនិងច្បាប់។ ដោយឡែក ការវិភាគបាន បង្ហាញថា តម្លាភាពនៃការប្រើប្រាស់ថវិកាកម្មវិធីនៅអង្គភាពថវិកាសាមីនៅមានកម្រិតនៅឡើយ ព្រោះតម្លៃ M (២.៧៧) មានន័យថា ជាងៗក់កណ្ដាលសម្ដែងការមិនសប្បាយចិត្តចំពោះ សូចនាករមួយនេះ និងមធ្យមភាគជាភាគរយបង្ហាញថា ភាពពេញចិត្តនិងភាពពេញចិត្ត ទាំងស្រុងមានត្រឹមតែ ៤០.៨៧% ប៉ុណ្ណោះ។ ដូច្នេះ បើពិនិត្យទ្រឹស្ដីរបស់លោក Downley ឆ្នាំ២០០៦ ត្រង់ចំណុចទី១ យន្តការនៃការប្រើប្រាស់ថវិកាកម្មវិធីនៅមានកម្រិត ដោយអង្គភាព មិនបានធ្វើការពិភាក្សាឱ្យបានទូលាយជាមួយមន្ត្រីក្រោមឪវាទ។

ចំណែកចំណុចទី២ ក៏អង្គភាពរៀបចំគម្រោងថវិកាដោយមិនបានធ្វើវេទិកាសាធារណៈ ដែរ។ វិងចាប់ពីចំណុចទីៗដល់ទី៦នៃទ្រឹស្ដីខាងលើ ក៏អង្គភាពមិនបានអនុវត្ដឲ្យបានពេញ លេញផងដែរ។ ទន្ទឹមនឹងនោះដែរ ការទទួលខុសតាមផ្នែករបស់អង្គភាពថវិកាមិនទាន់មាន ភាពច្បាស់លាស់ ភាពមិនប្រក្រតីក្នុងការប្រើប្រាស់ថវិកាមិនត្រូវបានលាតត្រដាងឲ្យទូលាយ និងសេវាសាធារណៈរបស់អង្គភាពថវិកាមានភាពស្ពឹកស្រពន់ ដែលមានន័យថា តម្លាភាពនិង គណនេយ្យភាពនៃការប្រើប្រាស់ថវិកាកម្មវិធីនៅមានកម្រិត ដែលបណ្ដាលឲ្យអភិបាលកិច្ចពុំ មានភាពល្អប្រសើរ។

វិងបេកគំហើញរបស់ លោក Wirtz & Birkmeyer ឆ្នាំ២០១៥ ព្រឹត្តិបត្រអន្ដរជាតិស្ដីពី រដ្ឋាភិបាលបើកចំហ យើងស្រង់បានមូលដ្ឋានធំៗចំនួន ៤ ក្នុងការចូលរួមគឺៈ (១) ផ្ដល់ការ លើកទឹកចិត្ត (២) ផ្ដល់ឱកាសស្មើៗគ្នា (៣) ផ្ដល់សេរីភាពក្នុងការសម្រេចចិត្ដដោយផ្ទាល់ និងមិនផ្ទាល់ (៤) ផ្ដល់សេរីភាពក្នុងការបញ្ចេញមតិជាសាធារណៈ។ ដោយឡែក លទ្ធផល នៃការវិភាគបានបង្ហាញថា អ្នកឆ្លើយសំណួរច្រើនជាង ៥០% សម្ដែងការមិនពេញចិត្ដចំពោះ សមាសភាគមួយនេះ (ភាគីៗក់ព័ន្ធ)។ បើប្រៀបធៀបរបកគំហើញនេះនឹងរបកគំហើញរបស់ លោក Wirtz & Birkmeyer ឆ្នាំ២០១៥ យើងឃើញថា ការលើកទឹកចិត្ដ ការផ្ដល់ឱកាសស្មើគ្នា ការផ្ដល់សេរីភាពក្នុងការសម្រេចចិត្ដ និងការផ្ដល់សេរីភាពក្នុងការបញ្ចេញមតិជាសាធារណៈ នៅមានកម្រិត។ ដូចthis ការសម្រេចចិត្ដពីភាគីៗក់ព័ន្ធក្នុងអង្គភាពថវិកាក៏នៅមានកម្រិតដែរ ដែលជាហេតុបណ្ដាលឲ្យអភិបាលកិច្ចពុំមានភាពល្អប្រសើរផងដែរ។

កម្រិតនៃការរៀៀជាក់នៃការវិភាគមិនឆ្នៃន័យ (Cronobach's Alpha)

ដើម្បីវិភាគកម្រិតនៃភាពជឿៀកជាក់ (Cronobach's Alpha) ស្មេរប្រើកម្រងសំណួរដែល មានសូចនាករសរុប ចំនួន៣១ ដែលត្រូវបានបែងចែកជាពីរផ្នែកគឺៈ (១) សូចនាករស្ដីពី តម្លាភាពនិងគណនេយ្យភាពនៃការប្រើប្រាស់ថវិកា ចាប់ពីសំណួរទី១ដល់ទី២២ក្នុងតារាងទី១ និង (២) សូចនាករស្ដីពីភាគីៗក់ព័ន្ធ ចាប់ពីសំណួរទី១ដល់ទី២២ក្នុងតារាងទី២។ ស្មេរបាន ពិភាក្សាយ៉ាងល្អិតល្អន់ទៅលើកម្រងសំណួរនេះ មុននឹងយកទៅប្រើក្នុងការសម្ភាស និងបាន ធ្វើ Cronobach's Alpha តេស្ដ ដែលចេញលទ្ធផលអាចទទួលយកបានដូចបង្ហាញក្នុង តារាងទី៣ខាងក្រោមនេះ។

ការធ្វើ Cronobach′s Alpha តេស្ដក្នុងតារាងទី៣នេះបង្ហាញថា៖ (១) ដំណាក់កាលទី១ គោលការណ៍ និងនីតិវិធីហិរញ្ញវត្ថុនិងគណនេយ្យ ចំនួន០៦សំណួរ មានតម្លៃ០.៧៥ (២) ដំណាក់កាលទី២ តម្លាភាពនិងគណនេយ្យភាព ចំនួន២២សំណួរ មានតម្លៃ០.៨២ (៣) ដំណាក់កាលទី៣ ការចូលរួមពីភាគីពាក់ព័ន្ធ ចំនួន០៩សំណួរ មានតម្លៃ០.៨២ និង (៤) ដំណាក់កាលទី៤ ប្រសិទ្ធភាពនៃការប្រើប្រាស់ថវិកាកម្មវិធី ចំនួន០៦សំណួរ មានតម្លៃ 0.0៣�។ តាមគោលការណ៍ Cronobach's Alpha ចំពោះតម្លៃ Cronobach's Alpha ចាប់ពី 0.៧ ឡើងទៅជាតម្លៃវិជ្ជមាន ដែលអាចទទួលយកបាន (Worl Bank, 2010)។

តារាងទី៣. បង្ហាញលទ្ធផលនៃការធ្វើតេស្ដ

សមាសភាគ	ចំនួនសំណួរ	**Cronobach's Alpha**
តម្លាភាពនិងគណនេយ្យភាព	22	0.82
ការចូលរួមពីភាគីពាក់ព័ន្ធ	9	0.72

សេក្ដីសន្និដ្ឋាន

ក្នុងផ្នែកខាងគ្រោះពីតម្លាភាពនិងគណនេយ្យភាពនៃការប្រើប្រាស់ថវិកាកម្មវិធី យើងបាន ប្រើសូចនាករដល់ទៅ២២។ ផ្នែកលើលទ្ធផលនៃការវិភាគនេះ យើងអាចសន្និដ្ឋានបានថា តម្លាភាពនិងគណនេយ្យភាពនៃការអនុវត្តថវិកាកម្មវិធីរបស់អង្គភាពវិភាគមួយនេះនៅមានកម្រិត ព្រោះអ្នកធ្លើយសំណួរច្រើនលើសលប់សម្ដែងការមិនសប្បាយចិត្តចំពោះការមិនបង្ហាញព័ត៌មាន ហិរញ្ញវត្ថុនិងគណនេយ្យឱ្យបានទូលាយ ជាហេតុនាំឱ្យមានការសង្ស័យក្នុងអង្គភាពវិភាគ។

ក្នុងការវាស់ផ្នែកភាគីពាក់ព័ន្ធ យើងបានប្រើសូចនាករចំនួន០៩។ យោងតាមលទ្ធផលនៃ ការវាស់ យើងអាចសន្និដ្ឋានបានថា ផ្នែកភាគីពាក់ព័ន្ធកម្រិតកណ្ដាលពុំត្រូវបានអនុញ្ញាតិឱ្យ ចូលរួមសម្រេចចិត្តពេញលេញក្នុងការរៀបចំផែនការថវិកា និងការអនុម័តថវិកាឱ្យទូលាយ នោះទេ។ សកម្មភាពទាំងនេះធ្វើឡើងត្រឹមថ្នាក់គណៈគ្រប់គ្រងជាន់ខ្ពស់ និងផ្នែករដ្ឋទេយ្យតែ ប៉ុណ្ណោះ។

សេចក្ដីថ្លែងអំណរគុណ

លោក ប៊ុញ ស៊ើន បេក្ខជនបណ្ឌិតផ្នែកគ្រប់គ្រងពាណិជ្ជកម្មនៃសាកលវិទ្យាល័យវៃស្សៀន សូមគោរពថ្លែងអំណរគុណចំពោះគណៈគ្រប់គ្រងនៃសាកលវិទ្យាល័យវៃស្សៀនដែលបានផ្ដល់

ការបណ្ដុះបណ្ដាលថ្នាក់បណ្ឌិតដល់រូបខ្ញុំបាទប្រកបដោយគុណភាព និងគុណវឌ្ឍិដែលអាច
ទទួលយកបាន។ ជាងនេះទៅទៀត ខ្ញុំបាទសូមគោរពសម្ដែងនូវការដឹងគុណយ៉ាងជ្រាលជ្រៅ
ចំពោះគណៈគ្រប់គ្រងនៃសាកលវិទ្យាល័យភូមិន្ទភ្នំពេញ ដែលបានផ្ដល់ឱកាសឱ្យខ្ញុំបាទបាន
សិក្សារៀនសូត្រ និងអនុញ្ញាតិឱ្យខ្ញុំបាទបានប្រមូលទិន្នន័យសំខាន់ៗជាក់ព័ន្ធនឹងប្រធានបទ
ស្រាវជ្រាវបំពេញលក្ខខណ្ឌបញ្ចប់ការសិក្សាថ្នាក់បណ្ឌិតផ្នែកគ្រប់គ្រងពាណិជ្ជកម្មរបស់ខ្ញុំបាទ។
មិនតែប៉ុណ្ណោះ ខ្ញុំបាទសូមគោរពថ្លែងអំណរគុណជាអនេកកប្បការចំពោះ ឯកឧត្ដម លោក
ជំទាវ និងអស់លោក-លោកស្រី ដែលជាគណៈនិពន្ធនាយកនៃ the Cambodia Journal of
Basic and Applied Research (CJBAR) ដែលបានទទួលយកអត្ថបទស្រាវជ្រាវរបស់ខ្ញុំ
បាទមកបោះពុម្ពក្នុងទស្សនាវដ្ដីនេះ។ ជាថ្មីម្ដងទៀត ខ្ញុំបាទសូមគោរពសម្ដែងនូវការដឹងគុណ
យ៉ាងជ្រាលជ្រៅបំផុតចំពោះសាស្ត្រាចារ្យណែនាំទាំងពីររូប ដែលបានលះបង់ពេលវេលាដ៏មាន
តម្លៃបំផុតរបស់លោកក្នុងការដឹកនាំនិក្ខេបបទរបស់ខ្ញុំបាទនេះ តាំងពីរដើមរឿងមកបានហួតទទួល
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តារាងទី១. ខ្លាតង្វាស់ពីតម្លាភាពនិងគណនេយ្យភាពនៃការប្រើប្រាស់ថវិកាកម្មវិធី

ល.រ	បរិយាយ	M	SD
1	តើអ្នកពេញចិត្តកម្រិតណាចំពោះការឆ្លើយតបនៃថវិកាដែលស្នើសុំទាំងអស់ទៅនឹងផែនការសកម្មភាពរបស់ដេប៉ាតីម៉ង់/ការិយាល័យរបស់អ្នក ?	2.83	1.12
2	តើអ្នកពេញចិត្តកម្រិតណាចំពោះថវិកាដែលបានពីការស្នើសុំត្រូវបានយកមកអភិវឌ្ឍសម្រាប់បុគ្គលអប់រំនៅដេប៉ាតីម៉ង់/ការិយាល័យរបស់អ្នក ?	2.78	1.12
3	តើអ្នកពេញចិត្តកម្រិតណាចំពោះការឆ្លើយតបដែលមានកម្រិតភាគរយទាបធៀបនឹងការស្នើសុំ ?	3.26	1.11
4	តើអ្នកពេញចិត្តកម្រិតណាចំពោះការឆ្លើយតបដែលមានកម្រិតភាគរយមធ្យមធៀបនឹងការស្នើសុំ ?	3.12	0.75
5	តើអ្នកពេញចិត្តកម្រិតណាចំពោះការស្នើសុំដែលមានការឆ្លើយតបក្នុងកម្រិតមួយរយភាគរយ ?	2.63	1.34
6	តើអ្នកពេញចិត្តកម្រិតណាចំពោះឯកសារដែលអង្គភាពថវិកាតម្រូវឱ្យអ្នកទូទាត់ត្រឡប់វិញ ?	2.92	1.03
7	តើអ្នកពេញចិត្តកម្រិតណាចំពោះការតម្រូវមានឯកសារសង្ខេបទូទាត់គ្រប់លក្ខខណ្ឌរបស់អង្គភាពថវិកា ?	2.86	0.97
8	តើអ្នកមានចិត្តកម្រិតណាចំពោះការតម្រូវឱ្យមានការដេញថ្លៃសម្រាប់គម្រោងចំណាយប្រចាំឆ្នាំរបស់អង្គភាពថវិកា ?	2.71	1.19
9	តើអ្នកពេញចិត្តកម្រិតណា ប្រសិនបើការឆ្លើយតបសំណើសុំថវិការបស់អ្នកមានការយឺតយ៉ាវ ?	3.36	1.11

10	តើអ្នកពេញចិត្តកម្រិតណា ប្រសិនបើព័ត៌មានហិរញ្ញវត្ថុនិង គណនេយ្យត្រូវបានផ្សព្វផ្សាយទូលំទូលាយក្នុងអង្គភាពបវិក ?	2.25	1.19
11	តើអ្នកពេញចិត្តកម្រិតណា បើព័ត៌មានហិរញ្ញវត្ថុ និងគណនេយ្យ ត្រូវបានផ្សព្វផ្សាយត្រឹមកម្រិតគណៈគ្រប់គ្រងអង្គភាពបវិក ?	2.95	1.01
12	តើអ្នកពេញចិត្តកម្រិតណា ប្រសិនបើព័ត៌មានហិរញ្ញវត្ថុ និង គណនេយ្យត្រូវបានផ្សព្វផ្សាយដោយប្រព័ន្ធអេឡិចត្រូនិច ?	2.29	1.11
13	តើអ្នកពេញចិត្តកម្រិតណាចំពោះប្រព័ន្ធព័ត៌មានហិរញ្ញវត្ថុបែប ប្រពៃណីកន្លងមក ?	3.58	1.03
14	តើអ្នកពេញចិត្តកម្រិតណាចំពោះព័ត៌មានហិរញ្ញវត្ថុដែលគ្រប់គ្រង និងផ្សព្វផ្សាយដោយប្រព័ន្ធគ្រប់គ្រងហិរញ្ញវត្ថុអេឡិចត្រូនិច ?	2.27	1.07
15	តើអ្នកពេញចិត្តកម្រិតណា បើបុគ្គលិកអប់រំបម្រើការនៅផ្នែក ហិរញ្ញវត្ថុនិងគណនេយ្យមិនមានជំនាញពិតប្រាកដ ?	3.75	1.17
16	តើអ្នកពេញចិត្តកម្រិតណា បើបុគ្គលិកអប់រំបម្រើការនៅផ្នែក ហិរញ្ញវត្ថុនិងគណនេយ្យមានជំនាញពិតប្រាកដ ?	2.17	1.28
17	តើអ្នកពេញចិត្តកម្រិតណាចំពោះការរៀបគរចំណូល-ចំណាយឱ្យ ចេញចូលតាមប្រកតែមួយ ?	2.19	1.16
18	តើអ្នកពេញចិត្តកម្រិតណាចំពោះដំណើរការស្នើសុំបវិកដែល តម្រូវឱ្យឆ្លងកាត់ការអនុញ្ញាតិគ្រប់ភាគីទាំង៣ផង់ន្ធ ?	2.80	0.99
19	តើអ្នកពេញចិត្តកម្រិតណា បើតម្រូវឱ្យមានការត្រូវពិនិត្យផ្ទៃក្នុង មុននឹងស្នើសុំបវិការបស់ដេប៉ាតឺម៉ង់សាមី/ការិយាល័យសាមី ?	2.68	0.98
20	តើអ្នកពេញចិត្តកម្រិតណាចំពោះក្រុមដេញថ្លៃនៃគម្រោងស្នើសុំ គ្រប់កូតារបស់ដេប៉ាតឺម៉ង់សាមី/ការិយាល័យសាមី ?	2.93	0.94

21	តើអ្នកពេញចិត្តកម្រិតណា បើតម្រូវឱ្យអង្គភាពថវិការបស់អ្នកមាន ស្ដង់ដារហិរញ្ញវត្ថុ និងគណនេយ្យរបស់អង្គភាពផ្ទាល់ ដោយអនុលោមតាមស្ដង់ដារបស់ក្រសួងសេដ្ឋកិច្ច និងហិរញ្ញវត្ថុ ?	2.26	1.11
22	តើអ្នកពេញចិត្តកម្រិតណា បើតម្រូវឱ្យមានការធ្វើសនកម្មជាប្រចាំដល់ អង្គភាពថវិកា ?	2.27	1.16
សរុបជាមធ្យម		2.77	1.04

<u>**ចំណាំ៖**</u> ខ្នាតវង្វាស់ពី ១ ដល់ ៥ (១ = ពេញចិត្តទាំងស្រុង, ៥ = មិនពេញចិត្តទាំងស្រុង)

M = *គិតជាមធ្យម*, *SD* = *គម្លាតស្ដង់ដា*

តារាងទី២. ខ្នាតវង្វាស់ផ្នែកភាគី។៣៣ក់ព័ន្ធ

ល.រ	បរិយាយ	*M*	*SD*
1	តើអ្នកពេញចិត្តកម្រិតណា បើអ្នកមិនតម្រូវឱ្យចូលរួមសម្រេចចិត្តទូលំទូលាយផ្នែកគម្រោងថវិកាកម្មវិធីរបស់អង្គភាពថវិកា ?	3.2	1.08
2	តើអ្នកពេញចិត្តកម្រិតណា បើអ្នកតម្រូវឱ្យចូលរួមសម្រេចចិត្តទូលំទូលាយផ្នែកគម្រោងថវិកាកម្មវិធីរបស់អង្គភាពថវិកា ?	2.35	1.03
3	តើអ្នកពេញចិត្តកម្រិតណា បើគម្រោងនៃថវិកាកម្មវិធីត្រូវបានសម្រេចត្រឹមគណៈគ្រប់គ្រងអង្គភាពថវិកា ?	3	0.96
4	តើអ្នកពេញចិត្តកម្រិតណា បើការធ្វើគម្រោងថវិកាកម្មវិធីត្រូវបានផ្សព្វផ្សាយទូលំទូលាយ ?	2.22	1.13
5	តើអ្នកពេញចិត្តកម្រិតណា បើបុគ្គលិកអប់រំរបស់អង្គភាពថវិកាទទួលបានព័ត៌មានហិរញ្ញវត្ថុ និងគណនេយ្យស្មើៗគ្នា ?	2.33	1.10
6	តើអ្នកពេញចិត្តកម្រិតណា បើអ្នកត្រូវបានផ្ដល់ឱកាសក្នុងការអនុម័តគម្រោងថវិកាកម្មវិធី ?	2.47	1.01

7	តើអ្នកពេញចិត្តកម្រិតណា បើគម្រោងថវិកាកម្មវិធីប្រចាំឆ្នាំត្រូវបានអនុម័តត្រឹមគណៈគ្រប់គ្រង ?	2.88	1.10
8	តើអ្នកពេញចិត្តកម្រិតណា បើការអនុម័តថវិកាកម្មវិធីរបស់អង្គភាពថវិកាចំណាយពេលយូរហួសការរំពឹងទុក ?	3.85	1.19
9	តើអ្នកពេញចិត្តកម្រិតណា បើការអនុម័តថវិកាកម្មវិធីរបស់អង្គភាពថវិកានេះត្រូវបានធ្វើឡើងតាមហាននុក្រម ?	2.74	1.10
សរុបជាមធ្យម		2.78	1.08

<u>**ចំណាំ៖**</u> ខ្នាតវង្វាស់ពី ១ ដល់ ៥ (១ = ពេញចិត្តទាំងស្រុង, ៥ = មិនពេញចិត្តទាំងស្រុង)

   M = គិតជាមធ្យម, SD = គម្លាតស្តង់ដា

The Standard Khmer vowel system: An acoustic study
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សេចក្តីសង្ខេប

ការសិក្សាអាគូស្ទិចលើភាសាខ្មែរកន្លងមក (Henderson 1952, Thomas & Wanna 1987-88, Ratree 1998, Woźnica 2009, Kirby 2014) មិនបានផ្តោតលើគ្រាមភាសាភ្នំពេញជាទម្រង់ស្តង់ដារនៃភាសានោះទេ។ ការសិក្សានេះវិញផ្តោតលើការពិពណ៌នាថ្នាក់លក្ខណ៍ស្រៈនៃស្តង់ដារភាសាខ្មែរក្នុងបរិបទជាក់លាក់មួយលើគ្រាមភាសាភ្នំពេញ។ បើទោះបីជាកន្លងមក មិនមាននិយមន័យច្បាស់លាស់អំពីស្តង់ដារភាសាក៏ដោយ ក៏នៅតែមានសញ្ញាណ «និយាយច្បាស់» (Speaking Clearly) ដែលអាចជួយបញ្ជាក់អំពីគ្រាមភាសាស្តង់ដារនៃភាសាខ្មែរបានដែរ។ ការសិក្សានេះបានបង្ហាញអំពីលទ្ធផលនៃការវិភាគបែបសូរវិទ្យាអាគូស្ទិចលើគ្រាមភាសាភ្នំពេញ។ ការសិក្សានេះបានរកឃើញថា ស្រៈក្នុងភាសាខ្មែរ-ភ្នំពេញ បានបង្ហាញពីលក្ខណៈសទ្ទតា និងសូរសាស្ត្រដូចទៅនឹងប្រព័ន្ធស្រៈក្នុងភាសាខ្មែរស្តង់ដារដែរ។

Abstract

Previous acoustic studies of the Khmer Language (Henderson 1952, Thomas & Wanna 1987-88, Ratree 1998, Woźnica 2009, Kirby 2014) do not concentrate on the Phnom Penh dialect (hereafter PP dialect) as the canonical form of Khmer. This study concentrates on describing standard Khmer vowel distinction in the specific context of the PP

dialect. Although there is no clear-cut definition of "Standard Khmer", the notion of "speaking clearly" (និយាយច្បាស់/nijiɜj cbah/) may help us to define standard Khmer dialect. This study reports the results of an acoustic-phonetic analysis of the PP dialect. The study finds that all PP Khmer vowels presented phonemically and phonetically in the standard Khmer vowel system.

Keywords: *standard Khmer, vowel system, duration, frequency, acoustics, Phnom Penh dialect*

Introduction

Khmer, the official language of the Kingdom of Cambodia, is one of the Mon-Khmer subgroups of the Austroasiatic Language family (Schmidt, 1905; Henderson, 1952; Huffman, 1967; Diffloth, 1992). One dialectal variety, Surin Khmer, is spoken by around 1.3 million ethnic Khmer people in the north-eastern and eastern provinces of Thailand. More than one million people of the Khmer ethnic group in the Mekong delta region of southern Vietnam (Minegishi, 2006) speak another variety called Lower Khmer. Linguists have well studied the Khmer has spoken in the northern and southern parts of the Central Khmer (e.g., Suwilai, 1995; Smalley, 1964; Jenner, 1976; Tran Van, 1974; Dhanan and Chartchai, 1978; Hoang Thi, 1986; Thomas, Dorothy, 1987; Phunsap, 1984; Cummings & Thomas, David, 1984; Thomas D., 1976; Pornpen, 1989; Ratree, 1998; Wichitkhachee, 1996; Thach, 1999; Ratree & Jongman, 2005; Kirby, 2013). Central Khmer, however, is less well known. Information about the Central Khmer dialect mainly comes from a studies, such as Aymonier (1874-77); Earst Kuhn (1889); Finot (1902); Maspero (1915); Martini (1946); Henderson (1952); Gorgoniyev (1966); Huffman

(1967); Ehrman (1972); Pinnow (1979); Headley (1977); Sakamoto (2005); Filippi & Hiep (2009) and Haiman (2011). While Khmer dialects in Vietnam and Thailand are relatively well studied, only minimal information is gathered about the Khmer dialect spoken in Phnom Penh, especially in the instrumental phonetic analysis. The studies of Khmer phonemic structure, vowels, and consonants mostly describe the Khmer language in the manner in which it was spoken a long time ago. The current manner of the Khmer language needs to be documented, especially the Khmer vowel system.

The recognized standard version of a language is generally based on a given dialect and can be defined concerning the contexts in which it will be used: media, education, and administration. Nowadays, *'Standard Khmer'* could be more or less assimilated to the Phnom Penh dialect. It is nevertheless not identical to the Phnom Penh dialect (hereafter PP dialect), as speech in Phnom Penh displays several features that are very often seen as differing from Standard Khmer. Moreover, due to modern Cambodian history, most people living in Phnom Penh nowadays come from the countryside (Filippi, 2009). Available descriptive documents describing the Khmer language are published at the French protectorate and later, until 1975. Nothing significant has been written since that time, mainly due to the political turmoil that has characterized Cambodian political life. The descriptions that we have at our disposal rely on two things: 1) the informants (chosen by the linguist). Most of the time, and contrary to the current leading trends in linguistics, the descriptions generally rely on only a minimal number of informants - very often, there is only one informant.

Variation has not yet become part of linguistic research, 2) the nature of phonetics theory at the time of the description. The descriptions, or as far as those particular studies are concerned, a transcription is very often highly dependent on the stage of advancement of phonetic theory. Several linguistic descriptions exist dating back to the French Protectorate (1863 - 1953) and Sangkum Reastr Niyum (1955 - 1970). These varying descriptions might not be good sources for determining standard Khmer pronunciation, but they may help us understand what kind of speech is acknowledged as valuable at that time. Studies from Finot (1902) and Maspéro (1915) are, of course, full of exciting information, but they are mute as far as any localization is concerned, and they do not consider that one Khmer variety could be preferred over another one. Martini's description (1946) is the first to mention the local source of its description, Phnom Penh. The choice to focus on the Phnom Penh dialect is not based on any evaluation that it was more prestigious than any other was. However, as Martini explains: "As a base for our description, we selected the Phnom Penh dialect. It stands in between Battambang, which is linguistically more conservative and the diphthongization of Cochin-china"(Martini, 1946).

Many authors have proposed vaguely distinct analyses of the PP Khmer vowel system. This vowel system may be in fragment in the view of the fact that the full degree of variation in pronunciation between individual speakers (Martini 1946, Henderson 1952, Pinnow 1980), even within a dialectal region (Earst Kunh 1889, Noss, 1968, Huffman 1968, Sakamoto 1977, Minegishi 1986, Ratree 1998, Filippi & Hiep 2009). The PP Khmer vowel

system is undoubtedly one of the most autochthonous because of its richness and complexity (Martini, 1946). The phonological opposition of the a-series and b-series, inherent vowels /ɒː/ and /ɔː/, and first register and second register are the characteristics of the PP Khmer vowel system (Finot 1902, Schmidt 1905, Maspero 1915, Martini 1946, Henderson 1952, Gorgoniyev 1966, Huffman 1968, Sakamoto 1977, Pinnow 1980, Diffloth 1984, Jenner 1987, and Ratree 1996). The characteristic of phonological opposition encompasses almost all vowels into the vowel splits, with few exceptions. The vowel groups or vowel splits, which differentiated by phonation types or voice qualities, are transformed by a normal or head voice, first register /ɑː/, and a deep slightly breathy or sepulchral voice, second register /ɔː/, accompanied by high pitch and dilation of the nostrils or lower pitch (Henderson, 1952).

A notable vowel distinction has been classified due to the tongue height and the participation and non-participation of the lips in its articulation and vowel length (Gorgoniyev, 1966). Consequently, the exact number of vowel phonemes is still subject to controversial discussions across dialectal variation. Moreover, the number of vowel nuclei and its values diversifies between dialects; differences exist even between the Standard Khmer vowel system, PP dialect, and that of the BS dialect or TK dialect on which the standard is based (Noss 1968, Sakamoto 1977, Minegishi 1986, Ratree, 1998). According to Martini (1946), PP Khmer vowel phonemes have only twenty-eight at that time. According to Henderson (1952), there are thirty-two vowel phonemes at that time of Khmer, placing the PP Khmer language

between Pacoh (30 vowels) and Bru (41 vowels) in terms of richness of the vocalic inventory. The other linguists Gorgoniyev (1966), Huffman (1968-70), Prom Mol (2003), Sun (2003), and Filippi & Hiep (2009) have, therefore, classified by only thirty-one vowels of PP Khmer vowel system with ten long, eight short monophthongs, and ten long, three short diphthongs.

The PP Khmer diphthong never has a subject of any unique research[1]. A phonological analysis of PP Khmer diphthong is based on falling and rising pitch contour and falling and tense or gliding[2]; it has a phonological significance of their own, varied from the other monophthongs historically (Henderson 1952, Gorgoniyev 1966, Huffman 1970). The PP Khmer diphthongs typically consisted of one steady-state and an offglide. The first component of these diphthongs has the same comparable value as the simple monophthongs, but the second component simply points to the target's direction shorter than the first component. However, the contrast is precise in short diphthongs; the first component of short diphthongs is shorter than the second component or offglide[3]. The number of PP Khmer diphthongs seems to be more abundant than other mutual dialects such as northern Khmer and southern Khmer. The exact number of PP Khmer diphthongs may be debatable from various approaches. According to

[1]Maspero (1915) described the latter diphthong as "primary or primitives"and the former as "secondary or posteriors". "Primary" diphthongs exist as they hae in the past, whereas "secondary" diphthongs have developed from simple vowels or even from clusters consisting of the consonant and vowel as the morpheme-final sequences.
[2]Henderson (1952) and Gorgoniyev (1966) used the same pitch contour as a falling and rising diphthong. However, Huffman (1970) described Khmer diphthongs as phonologically significant arising from a falling and tense contour. They involve a notable movement of the tongue from a high position to lower one and from the lower position to the higher one.
[3]Huffman (1970) described (Central) Khmer long monophthongs and long diphthongs, which are equivalent in length, are treated as sequences of two short vowels. The short diphthongs, which are equivalent in length to short vowels, have no long counterparts, and must be treated as unit phonemes.

Henderson (1952), there are twelve long diphthongs (three short diphthongs); most of them are the falling-pitch. According to Gorgoniyev (1966), there are ten long diphthongs (only one short diphthong) of PP Khmer by haft of them are falling-pitch. According to Huffman (1970) and Filippi (2009), PP Khmer has thirteen diphthongs with three short diphthongs. The table below is a diphthong illustration by various authors and various transcriptions.

Table 1. Khmer diphthongs

Graphs	ឥា/ឥៀ	ឥេ	ឥិ	ឥុ/ឥ៊ូ	ឥូ	ឥើ	ឥៅ	ឥឹ	ឥៀ/ឥឿ	ឥឺ	ឥក់	ឥុក់	ឥាក់
Henderson(1952)	iə/iə↓		æ↓	uə/ùə↓		ɔə↓	aɔ↓	aɤ↓	wə/ẁə↓			w̆ə↑↑	ĕɜ↑
Gorgoniyev(1966)	i:ə/e:a↓		a:e↓	u:ə↓	o:u↑	ɔ:a↓	a:o↑	a:ə↓	ɯ:ə↓		ĕɜ↑		
Huffman (1970)	iə↓	ei↑	æ↓	uə↓	ou↑	ɔə↓	aɔ↓	æ↓	iə↓	əi↑	ĕə↓	ŭə↑↑	ŏə↑↑
Filippi (2009)	iɜ↓	ɛe↑	æ↑	uɜ↓	ou↑	oa↓	aɔ↑	aɜ↑	iɜ↓	ɜə↑	ĭɜ↓	ŭɜ↓	ĕa↓
This study	iɜ/iə↓	ɛe↑	æ↑	uɜ↓	oʊ↑	oa↓	aɔ↓	aɜ↓	iɜ↓	ɜə↑	ĭɜ↓	ŭɜ↑↑	ĕa↓

This study, a phonological analysis of spoken PP Khmer diphthongs, proposes that there are only ten long diphthongs, not thirteen or fourteen:/iɜ↓, iə↓/, /ɨɜ↓/, /uɜ↓/, /aɛ↓/, /aɜ↓/, /aɔ↓/, /oa↓/, /ɛe↑/, /oʊ↑/, /ɜə↑/and finally three short diphthongs; /ĭɜ↓/, /ŭɜ↑↑/, /ĕa↓/ of PP Khmer. The analyses (e.g., Huffman 1970, Filippi and Hiep 2009) describe 13 diphthongs, and three short diphthongs, which are well-transcripted. Huffman (1970) and Filippi (2009) transcribed the words ទាប and ទៀប by the same diphthong as /tiɜp/, which is representative of some parts of the PP dialect. However, two words are realized separately as /iɜ/ in ទាប /tiɜp/

"short" and as /iə/ in ទៀប /tiəp/ "custard apple" in other dialects of Khmer,

including dialects used in the southern part of Phnom Penh.

There are other modern classifications of the Khmer vowel system, such as Khoun Sokhompou (1970). According to Khoun's dissertation, which was defended in Germany, the Khmer vowel system has 25 monophthongs and eight diphthongs. On the other hand, Gorgoniyev (1966) determined 31 monophthongs and diphthongs. Most importantly, according to Jean Michel Filippi (2009), there are about 31 Khmer vowels, 18 monophthongs, and 13 diphthongs. According to Huffman (1970a-b), there were only ten long monophthongs, and only eight long monophthongs have short counterparts[4]. For diphthongs, Huffman defined there are 13 diphthongs.

Notably, the pairs listed (Headley Jr. 1977; Huffman 1970b) form a proportional and one-dimensional contrast. The phoneme /i/ occurs only in loanwords from Sanskrit and Pali. It either has in complementary distribution with /iː/or has an alternative pronunciation, as in ទិព /tip/"magical" vs.

ទិព្ /tɨp/"divine" (Headley Jr. 1977). The distribution of /i/ makes it impossible

to find reliable sample words for the study, hence the omission of /i/ from the data set. This phenomenon could be part of the standardized character of modern Khmer pronunciation. The symbols used to describe the Khmer language are mainly derived from vowel signs. For instance, the uses of the following symbols [ə] [ɜ] [œ] to transcribe Khmer central vowels are

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[4]Huffman argued that not all long monophthongs have short counterparts.

uncommon. These symbols are, in fact, the front labialized French vowels that are different from the Khmer central vowels [ɨ] [ə] [ɜ] in modern Khmer. This simply means that the French language description strongly influenced a previous vision of Khmer phonetics. Previously, Henderson had contributed another highly emblematic description in the article: "*The Main Features of Cambodian Pronunciation*." Henderson raised many problems related to the Khmer vowel system in terms of registers. Within this description of the Khmer vowel system, the useful features and terminological explanations did not describe standard Khmer pronunciation at that time. The presence of phonological opposition indicates that: breathy voice registers vs modal voice registers. The natural explanation for this is that Henderson's main informant was a Khmer scholar, Keng Vannsak[5].

Table 2. Henderson's vowel classes

		First Register Unrounded		Rounded		Second Register Unrounded		Rounded
		Front	Back			Front	Back	
Long(Open and closed syllables)	Close	e		o	Close	i	ŭ̵	ŭ
	Open to Close	æ	ɐr	ɑo	Half-open	ĕ		ŏ
	Close	a			Open	ɛ̆	ɤ̆	ɔ̆
	Close to Open	iə	ɯə	uə	Close to open	iə	ŭ̵ə	ŭə
Short(Closed Syllables Only)	Close	(e)	ɤ	o	Close	(i)	ŭ̵	ŭ
					Close to centre			wə
	Open	a		ɔ	Open to center	ɛ̆ə		ɔə

Another critical description is Huffman's (1970a-b) description. This description is more phonemic than the phonetic description. He did not use

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[5]He was a high-level Cambodian intellectual, very concerned with language, literature, and civilization questions. He later wrote "Principles of Creating New Words". As Henderson's informant, Keng Vannsak did not speak using his own Kampong Chhnang dialect but derived his high standard of pronunciation from the Khmer script.

the International Phonetic Association (IPA) symbols Stricto-Sensu but a mixture of International Phonetic Alphabet (IPA) and traditional American Phonetic transcription. For instance, how consonant clusters are transcribed indicates that Huffman is not going deep into phonetic detail - he did not mention the small details distinguishing C1 & C2. Another interesting transcription is Huffman's treatment of the velar consonants [k] and [ŋ] in cases of front vowels /iː, eː, ɛː, aː/. Here each minimal pair relies more on the script than on the actual pronunciation; he did not consider palatalization after the front vowels and the opened diphthongs. Of these cases, for example, there are so many mistakes in transcription, such as:

ជីក "to dig" in actual pronunciation: /ciːc/, and in Huffman's transcription: /ciik/; ចេក "banana" in actual pronunciation: /ceːc/, and in Huffman's transcription: /ceek/; រែក "to carry on" in actual pronunciation: /rɛːc/, and in Huffman's transcription: /rɛɛk/; កាក់ "coin" in actual pronunciation:/kaʔ/, in Huffman's transcription: /kak/.

Table 3. Huffman's vowel system

Long vowels	/ ii, ee, ɛɛ, ɨɨ, əə, aa, ɑɑ, uu, oo, ɔɔ/
Long diphthongs	/ iə, ɨə, uə, ei, əɨ, ou, ae, aə, ao, ɔə/
Short Vowels	/ i, e, ɨ, ə, a, ɑ, u, o/
Short diphthongs	/ ĕə, ŭə, ŏə/

The determination of the Khmer vowel system is pointed out by an essential document, Y.A. Gorgoniyev's (1966) "*The Khmer Language*" that was translated from Russian to English Language in 1966 by V. Korotky. Gorgoniyev focused on Khmer phonetics and sound patterns of the Khmer

spelling system. Gorgoniyev's informant was Dr Long Seam. By investigating the Khmer vowel structure, Gorgoniyev found 21 monophthongs and ten diphthongs in the below minimal pairs, diphthongs, and vowel charts.

Table 3. Gorgoniyev's vowel classes

	Front		Central		Back	
1	iː	(i)	ɯː	ɯ	uː	u
	iːə		ɯːə		uːə	
2	eː		ə̆ː		o̝ː	or
	(e̝ːɑ)				oːu	
3	eː	(e)	əː	ə	oː	o
4	ɛː				ɔː	ɔ
					ɔːɑ	
5	aː	a			ɒː	ɒ
	ae				ɒːo	
			aːə			

This paper presents the Khmer vowel system in an acoustic-phonetic analysis. It also classifies the modern Khmer vowel system using current pronunciation and numerical descriptions on monophthongs and diphthongs. The main reason for selecting this vowel inventory to represent the standard Khmer vowel system is that there is a current trend of phonemic changes in modern Khmer pronunciation. Previously, the front vowel /i/, and /ɛ/ and back open-mid vowel /ɔ/ did not commonly occur in the closure syllabic structure of Khmer (Henderson 1952, Gorgoniyev 1966, Prom Mol 2012, Filippi & Hiep 2009). However, in the Phnom Penh dialect, there is an occurrence of /i/, /ɛ/ and /ɔ/ in such these words កាពិ/kaːpiʔ/"cheese", ម៉េច/mɛc/"how" and ជីន /cɔn/"people".

To conclude previous studies and to focus the research outcomes, 21 long and short monophthongs/ iː i, ɨː ɨ̆, uː ŭ, eː e, ɛː ɛ, aː a, ɘː ɘ, oː o, ɔː ɔ, ɒː ɒ, ɜ / and 13 long and short diphthongs /iɜ/: /ɨɜ/ ː /uɜ/ ː /aɛ/: /aɜ/: /aɔ/: /oa/: /ɛe/: /oʊ/: /ɜɘ/, /iɜ̆/, /ŭɜ/, /ɛ̆a/ of the Phnom Penh dialect were identified by placing them into a frame sentence. This vowel class is analyzed by an acoustic cure of the modern Khmer vowel system's sound patterns. The results of the present study will be presented in linear regression and chart.

Methods

Subject and materials: This paper analyzes the Khmer vowel system in terms of frequency domain and duration. First, native speakers who have permanent residence in Phnom Penh were selected. They were asked to pronounce many words, formally and casually. They were recorded using a computer program: Praat software with 32 bits and 44100 Hz sampling voice recording rate. The context of the recording was critical. To avoid our informants feeling uncomfortable or nervous in the recording room, we spent around 30 minutes explaining our recording procedures, how to place their mouth in front of the microphone, how to read the frame sentence, and how to repeat the sentence.

Twenty-one native Khmer speakers (12 females) from different backgrounds, occupations, and residences were selected for casual observation during the first stage of the Clearly-Speak observation procedure. They were assigned to engage in formal and casual speech with 168 lexical items. They repeated the items two times each. This process was designed to determine who had a clearer speech. As a result, only 4 Khmer

native speakers (2 females) from Phnom Penh were selected as the informants in this study. They possessed a clear voice and had experience in using a microphone and talking naturally in front of it. Their age ranged from 20 to 50 years old with either a bachelor or master degree and had been working in administration, education, or the media. Next, the participants were recorded by reading isolated words from a list. Then, they were asked to read 61 lexical items in a formal reading manner three times. For instance, they recorded the following frame sentence: ពាក្យនេះ អានថា...។ /piĕʔ nih ʔaːn tʰaː .../, then they pronounced the designated word. Here, we listed 61 lexical items, including 34 vowel nucleus clusters with 21 monophthongs/ iː i, ɨː ɪ̆, uː ŭ, eː e, ɛː ɛ, aː a, ɘː ə, oː o, ɔː ɔ, ɒː ɒ, ɜ / and 13 diphthongs /iɜ/, /ɨɜ/, /uɜ/, /aɛ/, /aɜ/, /aɔ/, /a/, /ɛe/, /oʊ/, /ɜɘ/, /iɜ̆/, /ŭɜ/, /ĕa/.

Experiment: The average duration of 34 vowels was measured in the monosyllabic and polysyllabic structures. The vowel durations were measured in milliseconds (ms). The measurement of vowel duration was used for both the visual and auditory cues. The auditory cues can be interpreted differently in different studies. This study was used to investigate all vowels' actual duration consisting of acoustic cues on the sound spectrum unit. Furthermore, voice onset time (VOT) was defined as vibration separations, specifically describing consonant and vowel nuclei. The time between samples was 0.09 seconds (90 milliseconds). The potential time resolution of a recording on Praat Windows is reported as around 112.848980 seconds. The words' position and function within the frame sentence were used to avoid the vowel nucleus deformation caused by a lack

of sentence stress. Some vowel distribution patterns are complicated to find words for that provide an appropriate environment for the vowels commonly used by the Khmer native speakers.

Figure 1. Praat speech synthesizer and automatic alignment

/p iɛ̆ ʔ/   /n   i   h/   /ʔ   aː   n/   /tʰ   aː /   /k   ɛ   j/
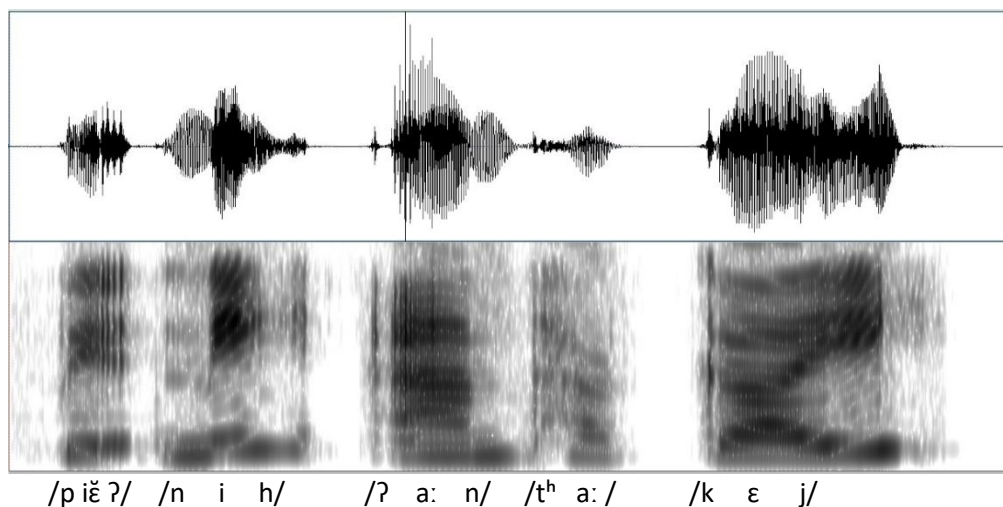
The unnatural word stress, vowel duration artifacts, and even refusal to read a word ("There is no such word") often were caused by the speakers' lack of familiarity with a lexical item. Whenever possible, such gaps in data were filled by the vowel in question taken from different words and sentences. This particular issue concerns the second measurement. Not all of the vowel samples were featured in the research because Khmer sequences of the type /VA/ (vowel + approximant) are traditionally interpreted as two-phoneme sequences (Huffman 1970a-b). The graph illustration of the results shows how vowel duration could be interpreted in complex word classes and sequences.

Segmentation: Our acoustic data was annotated and segmented using Praat 6.0.36. (2016) speech synthesizer and automatic alignment. This application was used to measure the total frequency and duration of all assets V1 and V1+V2 in the nucleus cluster, accommodated by C1 release or plosive, final consonant closure, and possibly a release in transitional vocoid or syllabic rime. Our analytical data were stored and analyzed according to articulation, vowel variation, and the linear regression and plotted using Microsoft Excel 2016. Acoustic cues and spectral combinations were highlighted by observing a periodic waveform, an increase in signal energy at C1 release or plosive, and a formant structure region. In Khmer's syllabic structure, the final consonants' phonemic structure's abstract element was always a closure consonant, unreleased, with an invisible spectrum.

Analysis: The results were analyzed by linear regression, specifying the intercepts for subjects and items. The use of main slopes, where appropriate (where models converge), is noted. The results were displayed in graphs and charts showing average frequencies, F1 and F2, and vowel duration in the Khmer vowel system based on articulations and acoustic characteristics.

Results and findings

This paper displays an analysis of vowel quality according to acoustic characteristics. This study reveals that both F1 and F2 represent the various vowels' articulation in the Phnom Penh dialect and the standard Khmer dialect. A graph was created to display the Khmer vowels space by comparing these speakers' frequencies, F1, and F2. However, this paper is

only an outreached statistical study for determining Khmer vowels' characteristics and their function in acoustic-phonetic data.

Figure 3. Formant frequencies (f1/f2) of Four Native Khmer speakers (2017, PP Dialect), the formant values of all speakers enclosed in circles have converted to the scale of differences between those speakers with closeness and openness of the syllables. The vowel's places of articulation have been allocated with the circles by their frequencies.
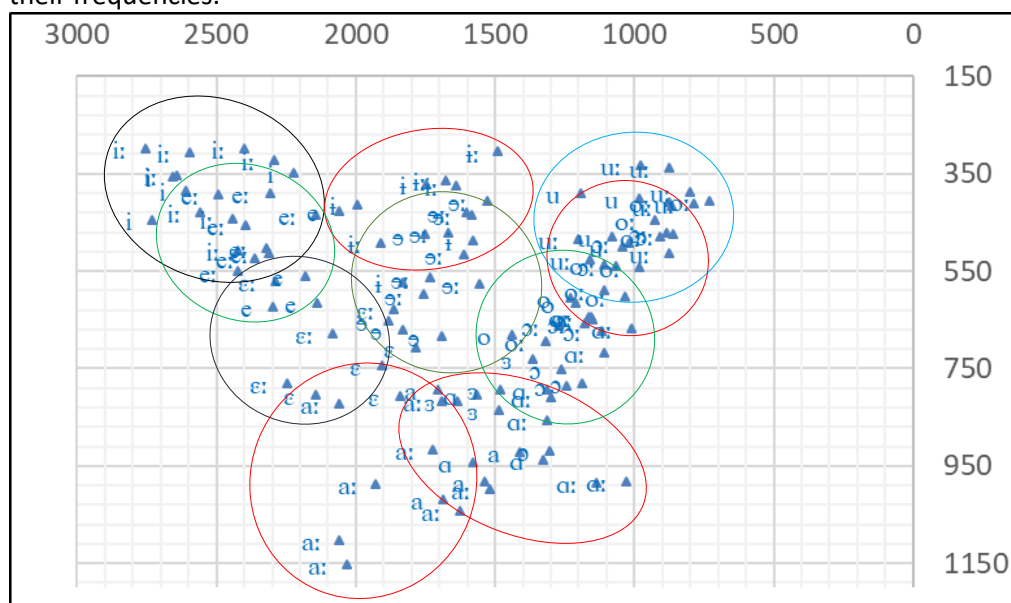
The above diagram shows the place of articulation of vowels in the vertical axis that is generally linked with high, mid-high, mid-low, and low vowels, a tongue position in the vertical axis. Another explanation relies on the tongue movement along the horizontal axis and allows the front, central, and back vowels' specifications. The above diagram shows only long and short monophthongs.

In the experimentation of vowel formants, data is organized according to maximums and minimums of vowel frequencies. The above table shows the place of articulation of vowels with regards to the characteristics of frequencies. The explanation is mainly focused on how F1 can be modified by the openness and closeness of vowels.

The table shows that the maximum of long vowels is higher than the short vowels by openness. On the contrary, the minimum of both the long and short vowels is reduced, and it indicates that the short vowel is lower than the long vowel by closeness. Vowel frequency, F2 is also structured by the front, central, and back vowels according to the tongue position and its movements in the vertical axis. The maximum number of long vowels is higher than short monophthongs. Conversely, the minimum of long monophthong is lower than short vowels. The long front monophthong seems to be determined more by position at the front than by shortness of length; the short back monophthongs are shown further back than the long monophthongs.

**Table 4.** Standard Khmer monophthongs (Max and Min)

Max/Min	F1	F2
Max	1152	2755
Min	297	731
Max	1019	2731
Min	347	983

Average Khmer Monophthongs. A Standard Khmer vowel system chart was created by the horizontal and vertical axis based on vowel frequencies. This analysis reveals a few questions about the inconsistency in vowel charts and vowel places that occur only in opened-syllabic structures.

Figure 4 shows the average vowel frequencies and indicates the value of the first and second frequency of all 21 monophthongs: 10 long monophthongs and 11 short monophthongs. According to the value found for F1, all long vowels were lower than short vowels with two exceptions. The long vowel [aː] in the opened-syllabic structure is higher than the short vowel [a], and the long vowel [aː] in a closed syllable is lower than the short vowel [a]. These frequencies revealed that

the coda or final consonant could modify vowels in the closed syllable. The coda or final consonant in the syllabic structure can affect the vowel nucleus, such as vowel quality and length. These results show that long vowels are more closed than short vowels, except [a:]. Long vowels are higher in quality.

Figure 4. Mean vowel frequencies (F1, F2)
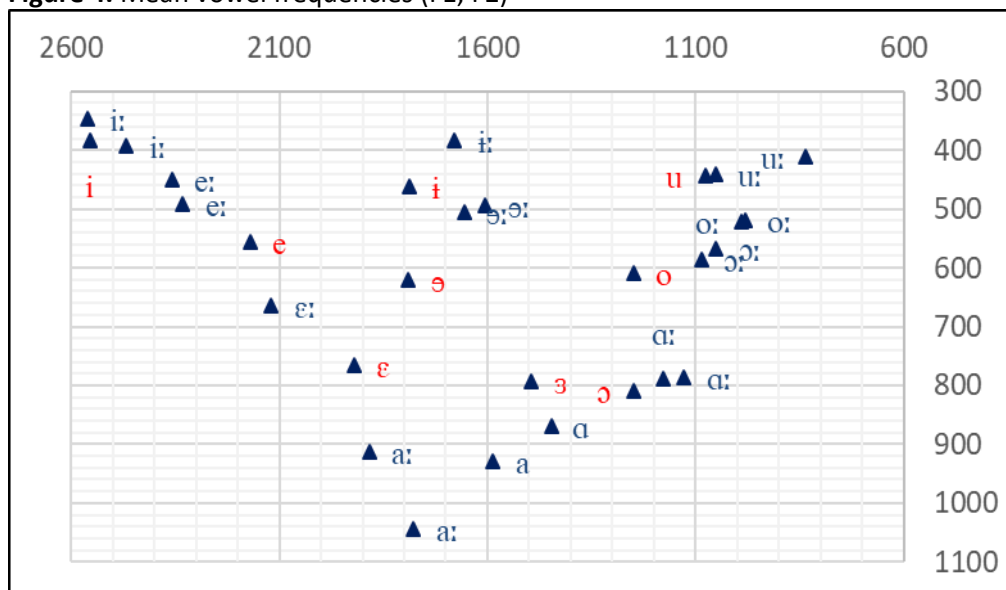
Most importantly, in terms of backness, all short back vowels are further in front of their counterparts. With frontness, long vowels are more back than their counterparts. For central vowels [ɨ:, ɨ; ə:, ə], long vowels are centralized in comparison to front and back vowel frequencies. The short vowel [a] seems to be more centralized comparing to other vowels.

Long and Short Diphthongs. This part was the most challenging part of the acoustic measurement and analytical process of the Khmer vowel system, especially for diphthongs. As a result, the first element of standard Khmer diphthongs was higher than the second element of its combination. The descriptive approach of vowel frequencies indicated, both in the spectrogram and sonogram, that the second vowel unit (V2) was dominated, in two out of three cases by the first vowel unit (V1)

of a diphthong. Thus, the frequencies, F1 and F2, mainly represented only the first vowel unit in the vowel space in Figure 5[6].

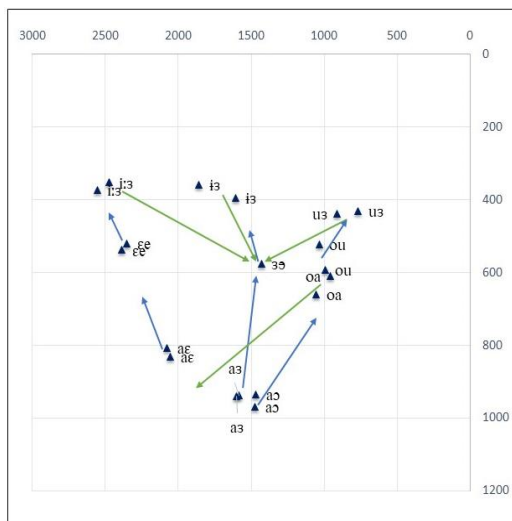**Figure 5.** Mean of long diphthongs   **Figure 6.** Mean of short diphthongs

In Figure 6[7], there are three short diphthongs. The chart shows how these recorded and measured by a computer program to analyze the apparent tendency of articulation and experimental phonetics of Khmer short diphthongs. The coarticulation of short diphthongs was too short to distinguish, and it was challenging to discover each frequency and duration. Nonetheless, the spectrogram shows no difference between the long and short duration of each comparison.

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[6]Note: The figure was formed by drawing arrows from the average /f1, f2/ measurements measured at 80% of first vowel duration (the tail of the arrows) to the corresponding values measured at 20% of vowel duration (the second vowel combination). The averages for short diphthongs ranged from 0.14 seconds to 0.32 seconds with a respective sampling rate of 44100 Hz and 32 bits.

[7]Note: The figure was formed by drawing arrows forms the average /f1, f2/ measurements measured at 80% of vowel duration (the tail of the arrows) to the corresponding values measured at 20% of vowel duration (the second vowel combination). Contrary to the long diphthongs' duration, short diphthongs commonly occur in the closure of syllabic structures /-h, -k, -ʔ/. The short diphthongs duration is similar to the long diphthongs' duration in the same contexts of syllabic closure structures. The average for short diphthongs ranked from 0.12 seconds to 0.14 seconds with a respective frequency sampling rate of 44100 Hz and 32 bits.

However, concerning speech perception and nucleus measurement, we found a difference between long diphthongs and short diphthongs in terms of the depth of pronunciation, closure, and openness, and release syllabic structure.

Vowel Duration. The long monophthongs ranged from 0.9 seconds to 0.27 seconds, and short monophthongs are from 0.6 seconds to 0.11 seconds. The closed syllables were usually shorter than opened syllables. The syllable illustrations are characterized simply to justify the acoustic data. If transitional elements are part of the syllable's phonological specification, we might expect to observe an increase in nucleus clusters' duration containing the pure vowel segment and closure syllable (C+ V1 +C). In the closure syllable, the most detailed analysis was the separation of the vowel nucleus's vibration and the plosive consonant at the end of the word, excepting fricative and even nasalized consonants that could be separated by voice onset time. Both sonograms and spectrogram did not show the nucleus and coda's boundary in the Standard Khmer syllabic structure.

Figure 7 shows the vowel duration that is measured based on isolated words and frame sentences. The average of vowel duration is recorded in milliseconds (ms) and utilized spectrograms and waveform plots to analyze such features of the acoustic signal, as periodicity (instrumental cue, considering the ubiquity of /V+ Fricative Consonants/ and /V+ nasal Consonants/ syllable offsets in Khmer), /V+h/ formant patterns typical of some vowel categories and sound wave amplitude dynamics. Part of the waveform envelope is schematically represented on a spectrogram and sonogram. (A) The curve indicates a surge of voice wave amplitude. The transition from the periodic [a] to the non-periodic [h] is also clearly visible. (B) The last impulse of [a] is relatively weak; therefore, it is not counted in the vowel duration. The vowel duration data obtained are sorted and averaged

according to vowel type (long and short monophthong and long and short diphthong).

Figure 7. Mean duration of monophthongs (short and long)[8]
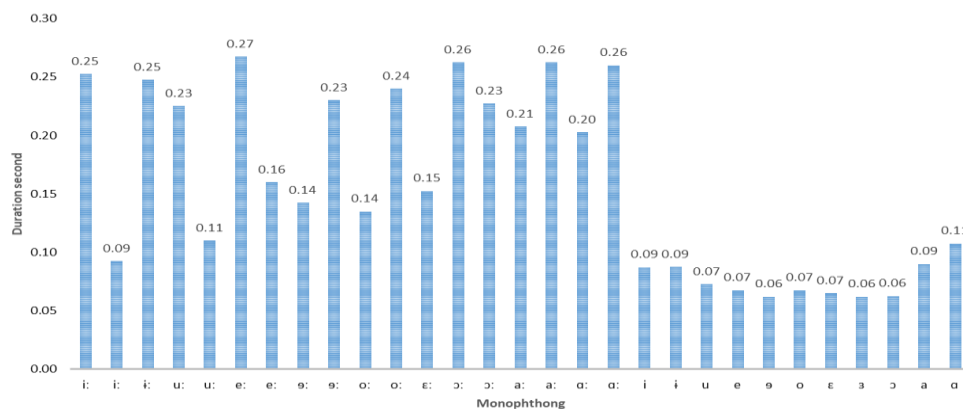
Figure 8. Mean vowel duration of diphthongs (short and long)
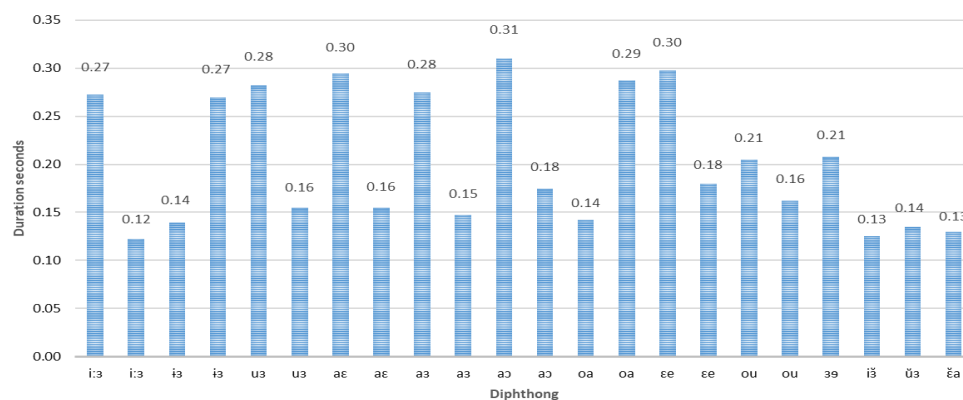
The patterns thus yielded are generally accordant with the classification of Khmer vowels. The ratio of the average duration of short to long vowels to long and short diphthongs is 76ms: 204ms: 215ms and 130ms. The table also shows the mean duration of all types of vowels with a maximum and minimum duration

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[8]Some vowels occur twice in the figure 7 and 8, the first vowel is characterized by the opened syllable structure and the second vowel is occurred in the closed syllable structure in the Khmer language.

classified by long and short vowels. Figure 8 shows the diphthongs of standard Khmer vowels with both long and short diphthongs. 10 long diphthongs and three short diphthongs are analyzed for the appropriate duration. The mean duration values may be sufficient to measure Khmer's vowel duration's phonological significance because of the considerable spread of vowel duration within the short and long vowel categories.

General Discussion and Conclusion

The measurement of modern Khmer vowels frequencies and durations has been the aim of this work. The first experiment on the phonetics of the standard Khmer vowel system was concerned with monophthongs. Ten long monophthongs and 11 short monophthongs were recorded, stored, and analyzed based on acoustic-phonetic characteristics. However, there were two common problems in monophthong measurement. First, the individual speakers differ in whether or not an increase in speech rate results in an increase in gestural overlap due to their employing different gestural implementations of the same cluster type (Tjaden & Weismer, 1998). This cluster type assumes the timing between the gestures that adapt the slow and fast speech. Another possibility is that speakers try to shorten the duration of the vowel while maintaining the relative timing. The issues are the syllabic closure structure of both long and short monophthongs completely changed the vowel duration, making it shorter than the opened syllabic structure. The long monophthong /i: / in the word ទី /ti: / ("place") of 0.25 seconds is longer than /i:/ in the word ជីក /ci:c/ (to dig) of only 0.9 seconds. This shortening of duration was similar to the short monophthong /i/ in the word កាពិ/kaʔpi/ (Khmer fermented paste) that has a duration of only 0.9 seconds.

The ten long diphthongs and three short diphthongs are classified according to what was expected from previous studies because the presentation of vowel frequencies, F1 and F2, categorized these diphthongs as the variations of speech. The long diphthongs /iɜ/ as in ទា /tiɜ/ (duck) and ទៀត /tiɜt/ (again) are completely different in the pronunciation of Khmer native speakers. Frequency measurement, for example, of /iɜ/; ទា /tiɜ/ was 354 Hz and /iɜ/; ទៀត /tiɜt/ was 374 Hz. There is, however, differentiation of vowel duration between ទា /tiɜ/ and ទៀត /tiɜt/, 0.27 seconds, and 0.12 seconds. In some cases, there are differences in such words as ទាវ ទៀត. Standard Khmer has two vowel distinctions /tiɜ/ and /tiət/, but in the Phnom Penh dialect, there is only the diphthong /tiɜ/ /tiɜt/ and the vowel contrast is identified in the standard Khmer vowel system. Also, there are /eː / and /ɛe/ in the Standard Khmer vowel system; in the Phnom Penh dialect, there is no difference between these two vowels; there is only one /eː/as in the words កែវ /keː/ and កែ /keː/.

Even though an instrumental phonetic analysis of Khmer dialects spoken in the Surin, Thailand (Wayland, 1998), and in PP dialect (Kirby, 2014) are the preliminary analysis that the present author should adapt; the problem that arose was the centralization of the open mid-vowel [aː] and open mid-vowel [ɑː] in the open syllable structure. Also, vowel length may be debatable in this case. Our audio files of [aː, ɑː] indicate that in the context of the open syllable, our speakers tended to lengthen the vowel nucleus. However, they are distinct in the close syllable. We suggest that the closed syllable structure, both long and short monophthong counterparts, could play a critical role in the distinction of the Khmer vowel system.

In conclusion, the Khmer vowel system is traditionally separated into two series (a and b) and registers (first and second). In Phnom Penh's long and short vowels, the first register vowels are lower and more open than the second register vowels. Moreover, the first register vowels are also diphthongized in Phnom Penh, respectively, similar to the BB vowels reported by Ratree Wayland (1998). However, the short vowels, for /o/, /ɔ/, /ɑ/, and /a/, are more centralized than the long vowels. Even though, in general, the Phnom Penh vowel system is a canonical form of the standard Khmer vowel system, some different structures and variations exist both in phonology and in phonetics.

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Factors influencing the reduction of plastic bag consumption in Cambodian supermarkets

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សង្ខិត្តន័យ

នៅឆ្នាំ២០១៧ រាជរដ្ឋាភិបាលកម្ពុជាបានដាក់ចេញអនុក្រឹត្យលេខ១៦៨ អនុក្រ.បក ស្តីពីការគ្រប់គ្រងថង់ប្លាស្ទិកៗ អនុក្រឹត្យនេះយកថ្លៃ០,១០ដុល្លារ (៤០០ រៀល) ក្នុងមួយថង់ពីអ្នកប្រើប្រាស់នៅតាមផ្សារទំនើបៗ ទោះជាមានអនុក្រឹត្យនេះក៏ដោយ ការកាត់បន្ថយថង់ប្លាស្ទិកតាមបណ្ដាផ្សារទំនើបនៅមានកម្រិតនៅឡើយៗ ការសិក្សា នេះបានវិភាគលើកត្តាជាទទិព្វលដល់ការកាត់បន្ថយថង់ប្លាស្ទិកតាមផ្សារទំនើបនានា ក្នុងទីក្រុងភ្នំពេញនៃប្រទេសកម្ពុជាៗ កត្តាទាំងនោះរួមមាន លក្ខណៈសេដ្ឋកិច្ចសង្គម ព័ត៌មាន ចំណេះដឹង អាកប្បកិរិយា ការអនុវត្តដាក់ស្ដែង និងធន្ទៈក្នុងការបង់ថ្លៃលើ ថង់ប្លាស្ទិកៗ ការសិក្សាបានស្ទង់មតិអតិបិជនចំនួន៤០៣នាក់ នៅក្នុងផ្សារទំនើប ចំនួន៥ទីតាំងៗ ការសិក្សាបានរកឃើញថា កង្វះព័ត៌មាននិងចំណេះដឹង រួមទាំង អាកប្បកិរិយា និងការអនុវត្តមិនល្អ បានធ្វើឱ្យការកាត់បន្ថយថង់ប្លាស្ទិកជួបបញ្ហា ប្រឈមៗ អតិបិជនមានអាកប្បកិរិយាអវិជ្ជមានចំពោះភាពលំបាកនៃការកាត់បន្ថយ ថង់ប្លាស្ទិកៗ ដូច្នេះ ការប្រើប្រាស់ថង់ប្លាស្ទិកមានចំនួនច្រើន (ចន្លោះពី១ទៅ៧ថង់) រាល់ពេលពួកគេទៅផ្សារម្ដងៗៗ ធន្ទៈបង់ប្រាក់របស់អតិបិជន(WTP) មិនតំណាងឱ្យ ចំនួនថង់ប្លាស្ទិកដែលពួកគេបានប្រើប្រាស់នោះទេៗ ដូច្នេះ ការសិក្សាបានស្នើឱ្យ បង្កើនថ្លៃហូតដល់ ០,១២៥ ដុល្លារ (៥០០រៀល) ក្នុងមួយថង់ ដើម្បីឱ្យការកាត់ បន្ថយថង់ប្លាស្ទិកមានប្រសិទ្ធភាពៗ Binary Logistic Regression បានបញ្ជាក់ថា

ព័ត៌មាន ឥរិយាបថ និងការអនុវត្តល្អប្រសើរ ទំនងជាមានឥទ្ធិពលគួរឱ្យកត់សំគាល់ចំពោះការកាត់បន្ថយថង់ផ្លាស្ទិកនៅតាមបណ្ដាផ្សារទំនើបនានា។

Abstract

In 2017, the Royal Government of Cambodia (RGC) introduced Sub-Decree 168 on the Management of Plastic Bags. It legislated that a 0.10 USD fee would be paid by consumers for each plastic bag they were provided at a supermarket. However, the reduction in plastic bag consumption by supermarkets has been quite limited. This paper analyses the factors that influence the reduction of plastic bag use by supermarket customers in Phnom Penh. It considers socioeconomic characteristics, access to information, existing knowledge, attitudes, and practices, as well as the willingness to pay a fee to use a plastic bag. A survey of 403 customers in five supermarkets was conducted to assess these factors. The study reveals that lack of available information, and poor knowledge, attitudes, and practices presented challenges for the goal of reducing plastic consumption in supermarkets. The inconvenience of a reduction in plastic bag use was found to result in negative attitudes towards the fee. Plastic bag consumption remained high at 1 to 7 bags per visit to a supermarket. Willingness-to-pay the scheduled fee was shown to have minimal influence on the number of plastic bags they used. Thus, this study recommends an increase in the fee to 0.125 USD per bag. A binary logistic regression was used to show that greater access to information, as well as changes in knowledge, attitudes, information, would have a significant influence on the reduction of plastic bag use in supermarkets.

Keywords: plastic bag consumption; willingness-to-pay; Sub Decree 168; access to information; knowledge, attitudes and practices

Introduction

 Plastic bags have become a popular packing method for consumers due to their ease-of-use, availability, and price (Adane & Muleta, 2011) and a

popular globally, especially in urban areas (Boadi & Kuitunen, 2003; Idris et al., 2004). In 2015, the worldwide annual production was estimated to be 381 million tons (Ritchie & Roser, 2018). Plastic waste is a major environmental concern (Wright & Kelly, 2017; Jang et al., 2020). The scale of plastic bag consumption is strongly correlated with customer behaviors, socioeconomic characteristics, knowledge, attitudes, and practices (Laroche et al., 2001). Encouraging consumers to reduce plastic bag use is considered useful in reducing this consumption (Verghese et al., 2006; Adane & Muleta, 2011) by changing consumer attitudes (Coddington, 1990). However, in Phnom Penh, the factors that may influence this change remain unclear, which is a key constraint to the success of policies (Koeng et al., 2020). Phnom Penh has the highest level of plastic bag consumption in Cambodia, at approximately 10 million bags in total per annum or 2,000 plastic bags for each person in the city each year (UNDP, 2019). The identification of the factors the influence the reduction of plastic bag consumption is considered to be useful information for developing more effective and policies and regulations to this end (Kum et al., 2005; Ritch et al., 2009).

This research explores the factors that influence the reduction of plastic bag consumption in Phnom Penh by analyzing customer behaviors in supermarkets. It first aims to identify the socioeconomic characteristics, information, knowledge, attitudes, and practices that influence plastic use among consumers. Second, it examines the willingness-to-pay (WTP) to reduce the consumption of plastic bags. Finally, it determines the factors that influencing plastic bag reduction in Cambodian supermarkets.

Factors Influencing on plastic consumption and reduction

Following a literature review, the factors influencing the reduction of plastic bag consumption and were placed into five categories. These included socioeconomic characteristics, access to information (policies and regulations), knowledge, attitudes, and practices. These are presented in (Figure 1).

Figure 1. Conceptual framework
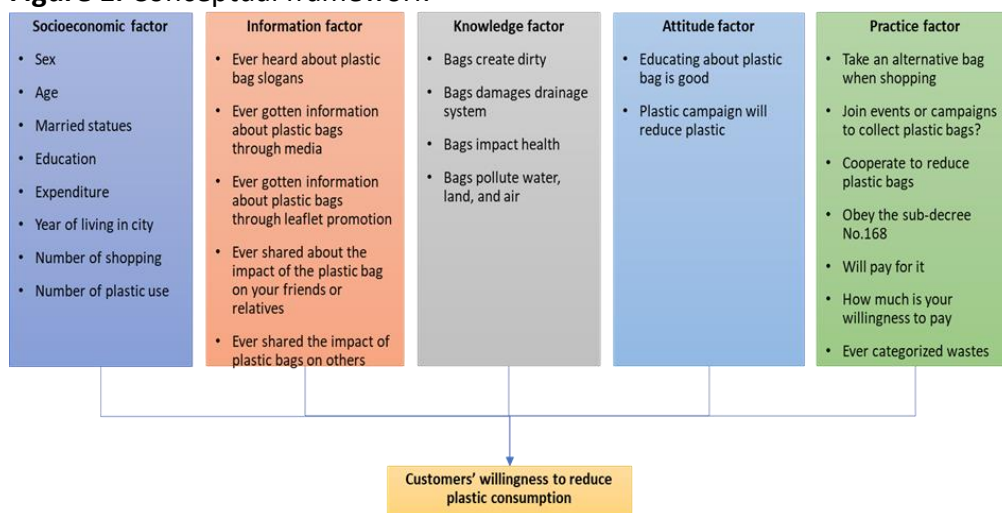
Adapted from (Laroche et al., 2001)

Socioeconomic characteristics

The socioeconomic characteristics of consumers impact plastic bag consumption (Kaliyaperumal, 2004). Residential location, education levels, and occupation have been shown to influence a reduction in plastic bag use (He, 2012). A study conducted by (Berkowitz & Lutterman, 1968) claims that females, young people, those who are highly educated, and the middle class are more likely to reduce their use of plastic. (Zambrano-Monserrate &

Alejandra Ruano, 2020) have also found that female household heads are likely to use fewer plastic bags when shopping; and that urban people use more plastic bags than rural households. In the past, older people have been more likely to be concerned about the environment and as a result, use less plastic than younger people (Samdahl & Robertson, 1989). This is also confirmed by (Berkowitz & Lutterman, 1968), especially for single-use plastics.

Access to information

The Royal Government of Cambodia (RGC) has established four policies and regulations to reduce plastic consumption and manage its disposal (MoE, 2020). These include Sub-decree 168 on the Management of Plastic Bags, which charges a fee of 0.10 USD per plastic bag to customers of supermarkets; Sub-decree 235, on the Management of Drainage and Wastewater Treatment System that applies a penalty of between 12.5 USD and 1,250 USD to those who dispose of plastics into a drainage system; Inter-Ministerial Circular 1070 on State of Water Management in Phnom Penh and Sub-decree 113 on Urban Solid Waste Management. Campaigns are also conducted by NGOs aimed at increasing the number of items used per plastic bag (Quicksand, 2015). A reduce, reuse, recycle strategy has also been introduced at public and private institutions, as well as among individuals, with respect to reducing the consumption of plastic bags.

Access to information about policies and regulations related to plastic bag consumption is considered to be a major influencing factor in this study. Edwards & Kellett (2000) claim that government regulations and policies

facilitate the control and management of plastic consumption. Similarly, (Brucks, 1985) suggests that information encourages customers to change their decisions about careless plastic consumption. This is said to improve the knowledge, attitudes, and practices of customers (Chow et al., 2017). Thus, a lack of information about plastic reduction policies and regulations is considered to be a critical problem. In Cambodia, while information about plastic consumption and reduction policies and regulations have been transferred to customers, the enforcement of these policies has been limited (Koeng et al., 2020).

Customer Knowledge

Knowledge is defined in this study as an understanding of how the reduce plastic consumption that influences attitudes and practices. Knowledge is also related to using the information to make decisions (Brucks, 1985). Knowledge of plastic use from information campaigns can motivate customers to reduce their use of plastic (Reazuddin, 2006).

There is a range of arguments presented in the existing literature about the reduction of plastic consumption. (Afroz et al., 2017) analyzed the level of knowledge, awareness, and attitudes about plastic waste claimed that people who have more information and knowledge on plastic are more likely to recycle than those who don't. However, only knowledge related to the environment (e.g. plastic wastes pollute the environment, impact health, and kill marine life) was shown to make a significant contrition to the reduction of plastic use. Overall, the level of education (science and society) was not correlated with behaviors (Hasan et al., 2015). Thus, specific plastic

education has a greater potential to change people's attitudes and behavior towards the reduction of plastic consumption, and waste management (Chow et al., 2017).

Customer attitudes

Customer attitudes towards the reduction of plastic consumption may be categorized as being related to importance and inconvenience (Laroche et al., 2001). Importance is defined as the concern of customers for the environment and their willingness to reduce their use of plastic. This attitude is reinforced in their WTP for plastic waste management service through a plastic usage fee (Convery et al., 2007). Environmental concern is related to both personal and societal benefits. On the other hand, inconvenience is defined as customer feelings about reducing plastic consumption. For example, customers wish to use alternative bags when they shop, but this feels inconvenient. Recycling is considered to be good for the environment, but difficult and time-consuming.

Dilkes-Hoffman et al. (2019) claim that customers feel negative about plastic consumption, which has a strong correlation with plastic reduction. However, many customers cannot transfer this inspiration into action due to the inconvenience. This helps to explain the high WTP for plastic consumption, combined with the high usage rates of plastic bags.

Customer practices

Customer practices tend to be influenced by socioeconomic characteristics, access to information, knowledge, and attitudes (Chow et al., 2017). These practices can differ and include reducing waste, reusing,

recycling, or managing plastic waste; and may also be defined as consumer commitments to reducing plastic consumption and protecting the environment. For instance, consumers may be willing to support Sub-Decree 168, which introduces a 0.10 USD on the use of a plastic bag. They may also willing to co-operate to reduce their use of plastic when shopping; use alternative bags, or join a campaign to collect plastic waste in public spaces.

Figure 1 outlines a conceptual framework that illustrates how consumer willingness to reduce plastic consumption is linked to socioeconomic characteristics, access to information, knowledge about plastic, as well as attitudes and practices. These five factors help to assess customer behavior with respect to the reduction of plastic consumption. This paper uses this framework to discuss these concepts with respect to addressing the core problem of excessive plastic consumption, while also focusing on particular solutions that may be applied in Cambodian supermarkets. The five factors are used to demonstrate how customers act to reduce plastic consumption in response to policies such as Sub-Decree 168.

Research Methodology

This research uses an exploratory methodology to better understand the factors that influence the reduction of plastic bag consumption in supermarkets in Phnom Penh, Cambodia. To date, no studies have been conducted that identify these factors or determine the willingness to pay of customers to reduce plastic bag consumption in this context.

A purposive sampling approach was employed to select five research sites in Phnom Penh (see Figure 2). Three large markets (City Mall, AEON

Mall 1, and Rotana Plaza) were selected. These sites serve as entertainment zones that attract young adults as well. Two smaller markets were also selected that tend to attract older people (Super Store and Bayon Supermarket). Each of these supermarkets operate from 9 am to 10 pm, with a peak in shopper activity occurring in the evening. Late in the morning, customers visit the markets to purchase groceries. From the afternoon, until late evening, customers to buy food and drink items, as well as movie tickets and other forms of entertainment. Many types of single-use plastics are consumed in these supermarkets.

Figure 2. Study sites

Source: Google Maps

A sample of 400 customers of these supermarkets was selected based on a 95% confidence interval (Yamane, 1973) from a total population size of 1,470,303 of the Phnom Penh population in 2018 (PPCH, 2018). The questionnaire was piloted using three surveys to bring the total number of research participants to 403 customers. A systematic sampling approach was adopted by selecting every ninth customer exiting the supermarket entrance

to participate in the survey. The sampling interval was calculated by dividing the population size by the desired sample size (403). Key informant interviews were also conducted with experts from the Royal University of Phnom Penh.

A structured questionnaire was developed for the survey comprising five sections. The first section asked about the socioeconomic characteristics of the customers, such as gender, age, marital status, occupation, and income. The second section asked questions about plastic bag consumption, such as the frequency of supermarket visits, which supermarket people shopped at, the number of plastic bags used, and the purpose of plastic consumption. The third section inquired about the knowledge, attitudes, and practices of customers, such as where customers accessed information about plastic use; and their knowledge about plastic management (reuse, reduce, recycle) and plastic pollution. This section also included questions about customers attitudes related to the importance of reducing plastic bag consumption the inconvenience of measure in place to do so; as well as how customers use and manage plastic. These questions were intended to understand the actual practices of plastic bag usage in Phnom Penh. The fourth section asked questions to evaluate the WTP of customers to reduce plastic bag consumption through a bidding process. The final section of the questionnaire focused on general opinions about the reduction of plastic bag usage and other environmental solutions.

Socioeconomic characteristics, access to knowledge, attitudes, and practices of consumers were analyzed using descriptive statistics and a

frequency analysis, with the data visualized in tables and graphics. Data collected about WTP was assessed using one-way analysis of variance ANOVA), using a Tukey HSD Test. The test was used to determine the difference in the WTP of customers by occupation. The factors influencing plastic reduction were analyzed using a Binary Logistic Regression (Sung, 2010; Jayaraman et al., 2011), which used the following regression model:

$$\pi_i = \Pr\left(Y_i = \frac{1}{X_i} = x_i\right) = \frac{\exp(\beta_0 + \beta_1 x_i)}{1 + \exp(\beta_0 + \beta_1 x_i)} \qquad (1)$$

$$logit(\pi_i) = \log\left(\frac{\pi_i}{\pi_i - 1}\right) = \beta_0 + \beta_1 x_i \qquad (2)$$

$$logit(\pi_i) = \log\left(\frac{\pi_i}{\pi_i - 1}\right) = \beta_0 + \beta_1 x_{i1} + \cdots + \beta_k x_{kn} \qquad (3)$$

The results from the regression predicted the likelihood that a particular factor would contribute to a reduction in plastic bag consumption in supermarkets. The dependent variable "Do you reduce plastic bag when shopping" had two possible answers: Yes=1 and No=0. The logit distribution constraints estimated the probability as a value between 0 and 1. The independent variables used in the regression are identified (see Appendix 1). Analysis of the results was conducted using the SPSS 23 software package. Microsoft Excel was used to prepared charts, tables, and graphics for the report.

Result and Findings
Access to information, knowledge, attitudes, and practices

The characteristics of the supermarket customers surveyed were as follows. Overall, 63.3% of respondents were female, most were unmarried university students. Their monthly income was less than 250 USD. More than

half of the respondents (n=294) shopped at Aeon Mall 1 due to the facilities, level of services, and choice of items, compared to other supermarkets. The average age of respondents was 23. They came to the markets for food, drinks, and entertainment, such as movies, video games, and social gatherings.

In Cambodia, training, slogans, leaflets, and social media have all been used to disseminate information to the public. Both male and female customers were found to have received information about plastic bags via slogans (male 84%, female 76%), leaflets (male 73%, female 61%), and social media (male 81.8%, female 77.6%). Slogans and social media were considered to be the most effective method of disseminating, resulting in widespread awareness of information about plastic bag use.

Training about plastic consumption was divided into informal and formal categories within this study. Informal training was found to be more effective in disseminating information than formal training (classes, courses, or schools). Women were found to be less likely to join formal training (33.5%) than informal training (66.3%). Similar outcomes were found for men who were less likely to join formal training (54.7%) than informal training (75.7%), but more likely to access training overall.

While customers indicated that they received information from slogans, leaflets, and social media, as well as informal and formal training, most customers felt that they did not receive sufficient information through these sources. Among the 403 customers surveyed, only 39% (male 44.6%, female

34.3%) claimed they received sufficient information. Women (40.4%) believed they had less access to information than men (56.1%).

Figure 3. Access to information about plastics by gender
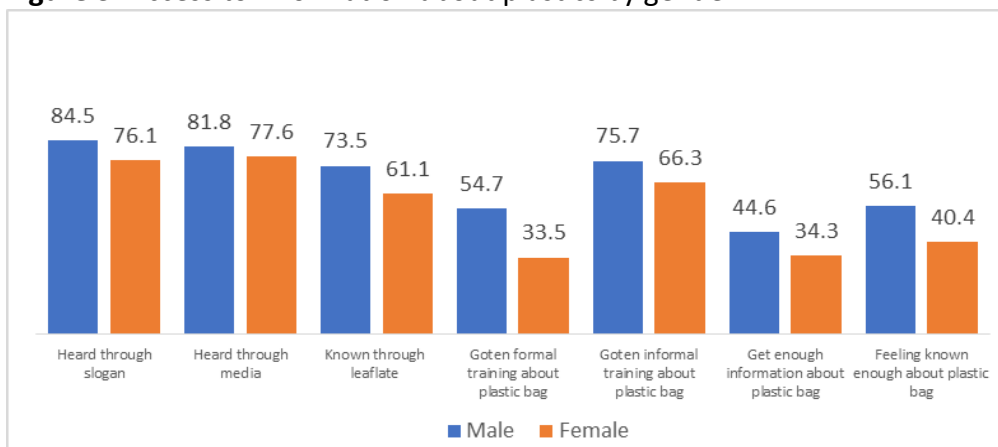
Customer knowledge about plastic bags such as it creating an unclean living environment; damaging drainage systems; impacting health; and polluting water, land, and air were widely acknowledged; with no significant difference between men and women. However, when considering knowledge levels by occupation, there were significant differences. Those with 'other' careers had less substantial knowledge about the impacts of plastic bag consumption, compared to students, government officers, and those working in the private sector.

Moreover, while environmental knowledge about plastic bags was high, technical knowledge was low. For example, only 48% of customers surveyed knew how to classify plastic wastes. Women (45.1%) were found to have less technical knowledge than men (54.1%), with all customers having very limited knowledge of the plastic qualities and recycling codes. They were not

aware of which plastic products were eco-friendly, single-use, or multiple-use (see Figure 4).

Figure 4. Plastic using codes

Source*:* (Wahab et al., 2006)

Positive attitudes related to plastic information and knowledge were found, with 92% of customers found to support Sub-Decree 168 and more than 68% agreeing that charging 0.10 USD per plastic bag was a good initiative for reducing plastic consumption in supermarkets. A high proportion of customers also supported education programs (92%) and awareness campaigns (89%) to reduce plastic use. Both men and women shared information and knowledge about the plastic bag with their relatives, friends (male 77%, female 74%), and other people (male 67%, female 65%). These positive attitudes demonstrate the connection between information and knowledge about plastic bags and consumer attitudes. However, customer attitudes towards plastic consumption and the inconvenience of reducing plastic bag use were not positive, which tends to be demonstrated in user practices.

It was found that single-use plastic bags were mostly used for foods and drinks and customers tended to use between a minimum of 1 plastic bag or a maximum of 7 plastic for each visit to the supermarket. Almost half of those

surveyed (43.8%) visited the supermarket at least twice per week. Survey respondents were found to use plastic bags due to their price (83%), convenience (95%), weight (96.8%), material (79.4%), and durability (61.8%). Customer attitudes were found to view plastic bag reduction as inconvenient, where they were aware that plastic caused problems, but could not reduce their consumption. Further, 57% of those surveyed indicated that they disposed of plastic waste in public areas; 81% disposed of plastic waste around their houses; 74% burned plastic waste; 44% buried plastic waste, while only 57% used alternatives to plastic bags for shopping.

Figure 5. Knowledge, attitudes, and practices related to a reduction in plastic bag use by gender
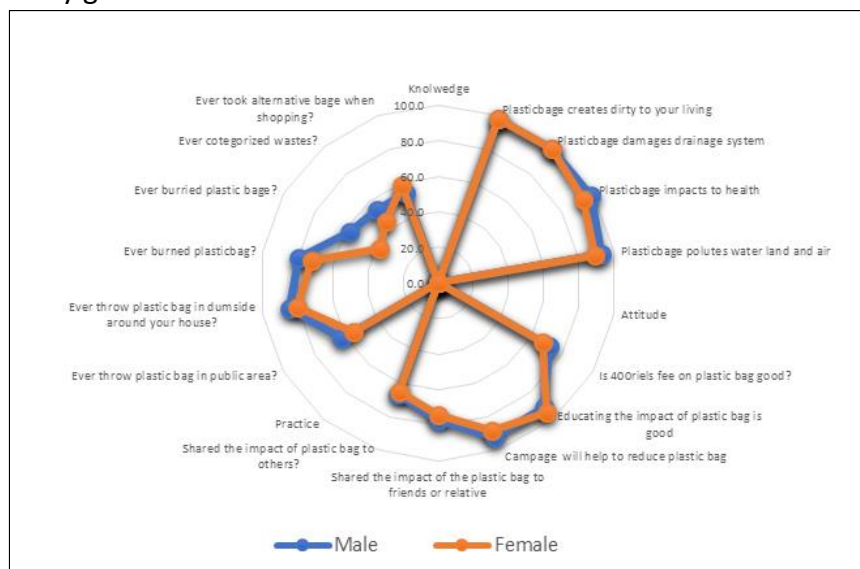
These results confirmed that a lack of detailed information and technical knowledge about the reduction of plastic use, as well as a perception of solutions being inconvenient led to plastic reduction policies and regulations in urban areas to be ineffective (Kum et al., 2005; Ritch et al., 2009). Figure 5

presents the results of the survey for the knowledge, attitudes, and practices of customers.

Willingness to Pay (WTP)

In response to the second research objective, the willingness to pay a plastic consumption fee was determined. It was found that 70.5% (n=280) of respondents indicated a positive WTP (min=0 KHR, mean=430 KHR, and max 2000 KHR). There was no significant difference in the WTP by gender, however, there was by occupation. A one-way analysis of variance using a Tukey HSD test revealed a significant difference between the WTP of students, those working in the private sector, and government officers; when compared to those working in other careers (P-*value* <0.05).

Government officers were found to have the highest WTP among these occupational groups. It was 321 KHR higher than the student group and 583 KHR higher than those working in other careers. However, the WTP of private-sector employees was not significantly different to students, government officers, or those working in other careers. Table 1 outlines the difference in WTP by different occupational groups at a significance level of 0.05 level (*).

Of the customers surveyed, 29.5% (n=117) were not willing to pay a fee to use a plastic bag (32.9% or n= 82 female; and 23% or n=32 male). They provided reasons including that they did not have money (7.6%); they would prefer to use an alternative bag (19.7%); that the supermarket should pay this fee instead of them (37.9%), or that they don't trust Sub-Decree 168 (4.5%).

Table 1. WTP for a plastic bag

(I) Occupation		Mean Difference (I-J)	Std. Error	P-*value*	95% Confidence Interval	
					Lower	Upper
Student	*Gov't officer*	-312.703[*]	118.429	0.044	-619.14	-6.27
	Private sector	21.913	76.400	0.992	-175.77	219.60
	Other	226.186	90.064	0.061	-6.85	459.23
Gov't officer	*Student*	312.703[*]	118.429	0.044	6.27	619.14
	Private sector	334.615	135.734	0.068	-16.60	685.83
	Other	538.889[*]	143.869	0.001	166.63	911.15
Private sector	*Student*	-21.913	76.400	0.992	-219.60	175.77
	Gov't officer	-334.615	135.734	0.068	-685.83	16.60
	Other	204.274	111.848	0.264	-85.13	493.68
Other	*Student*	-226.186	90.064	0.061	-459.23	6.85
	Gov't officer	-538.889[*]	143.869	0.001	-911.15	-166.63
	Private sector	-204.274	111.848	0.264	-493.68	85.13

Figure 6. *Average WTP for a plastic bag by occupation*
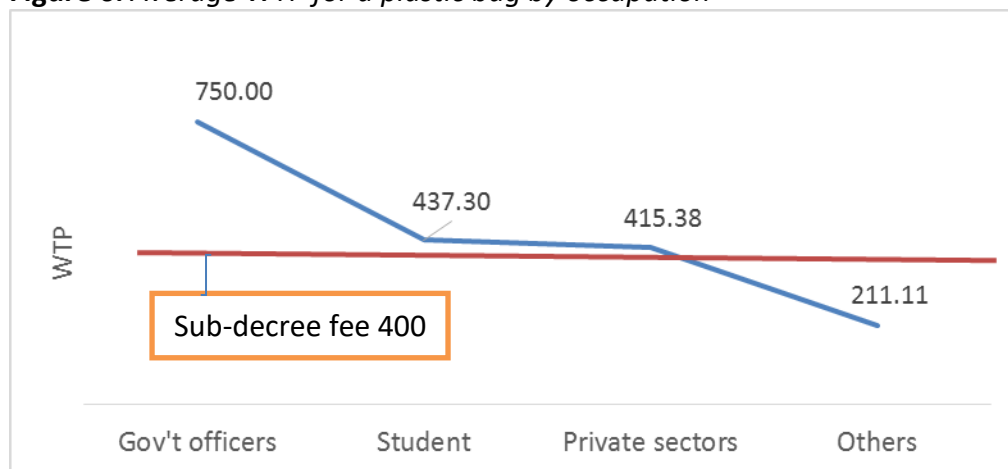
The fact that customers believe that the supermarkets should pay a plastic consumption fee indicates an attitude of inconvenience. The average WTP of supermarket customers was found to be higher than the fee introduced by Sub-Decree 168 (400 KHR).

Factors influencing a reduction in plastic bag consumption

This study used Binary Logistic Regression thresholds recommended by (Hair et al., 2014) and (Leech et al., 2014) to assess the significance of various factors in influencing a reduction in plastic bag usage; including significance levels (P-value <.05), Wald Statistics (χ^2>2) and Cox & Snell (R^2 <0.05). It was verified that a reduction in the use of plastic bag consumption was influenced by socioeconomic factors, access to information, knowledge, attitudes, and practices.

The results from the binary logistic regression were used to identify the most significant factors influencing a reduction in plastic bag. $Wald\ Statistic\ \chi^2\ (26, N = 195) = 108$, P-value <0.001 suggests that between 42% and 59% of the variance in influence could be explained by 26 independent variables (Appendix 1). This was supported by a Hosmer and Lemeshow Test, which gave $a\ Wald\ Statistic\ \chi^2\ (8, N = 195) = 6.2$, P-value >0.05. The threshold value of 0.500 predicted a percentage of agreeance with the model of 85.1% (PAC=85.1%), with an error of less than 15%. Detailed results from these statistical models are shown in Appendix 2. They include a coefficient (B), the standard error related to the coefficient (S.E.), the, Wald Statistic = $[B/S.E.]^2$, the number of degrees of freedom (d.f), the significance level of the coefficient (Sig), and the odds ratio of the individual coefficient Exp(B).

Of the eight independent variables related to the socio-economic characteristics of customers, two (*marital status* and *number of years residing in Phnom Penh*) had a negative influence on the reduction of plastic bag consumption. Other factors such as sex, age, educational level, household expenditure, time of purchase, and the number of plastic bags

used had no significant influence on the likelihood of reducing plastic bag use (P-value >0.05). None of the four independent variables associated with access to knowledge (*plastic bags create an unclean living environment; plastic bags damage drainage systems; plastic bags impact health; plastic bags pollute water, land, and air)* was found to have a significant influence on the reduction of plastic bag use. The attitudinal factors *education on the impacts of plastic bags is good* was not a significant influence, however, *plastic reduction campaigns will reduce plastic bag consumption* was found to have a positive influence (P-value <0.05, odds ratio = 10.66).

Of the five independent variables linked to access to information on plastic bag consumption, only two were found to have a significant influence. *Hearing a slogan about plastic bags* was positive correlated with a reduction in plastic bag consumption (P-value <0.05, odds ratio = 5.44), however s*haring information about the impact of the plastic bags with friends or relative* had a negative correlation. Customers who had never shared information about the impact of plastic bags were also not likely to reduce their consumption (P-value <0.05, odds ratio = 0.24).

Finally, of the seven independent variables associated with customer practices, two were found to have a significant influence on the reduction of plastic bag use: *joining events or campaigns to collect the plastic bags,* and *obeying the sub-decree* (P-value <0.05, Odd ration=4.65, odds ratio = 7.48). A singled variable was associated with a negative likelihood for reducing plastic bag consumption - *taking alternative bags to the supermarket* (P-value <0.05, odds ratio = 0.26). Put simply, customers who have never used an alternative bag for a supermarket visit are unlikely to reduce their consumption of plastic bags.

Discussion

In Cambodia, information about plastics is transferred to the public through several methods. Customers access information about plastic bags via slogans (male 84%, female 76%), leaflets (male 73%, female 61%), and social media (male 81.8%, female 77.6%). However, most respondents (61%) feel that they lack information about plastic consumption. Knowledge about plastic bags creating unclean living environments; damaging drainage systems; impacting health; and polluting water, land, and air was strong. However, customers tended to have limited technical knowledge about plastic bag recycling, with only 48% of respondents knowing how to classify plastic wastes using plastic codes. Attitudes towards reducing plastic consumption were positive, but the inconvenience of reducing plastic bag usage was negative. Thus, respondents were still found to use a large number of plastic bags each trip to the supermarket (between 1 and 7 bags). In terms of disposing of waste, 57% of respondents reported throwing waste into public areas; 81% threw plastic wastes in areas surrounding their houses; 74% burned plastic wastes; 44% buried burry plastic wastes, and 57% reduced plastic use by taking alternative bags when shopping.

Information on plastic usage is considered to be a major contributing factor in the reduction of plastic use (Brucks, 1985). There are considered to be two reasons why information is lacking among customers. The first is that even when respondents access lots of information in the forms of slogans, leaflets, and social media, these platforms do not provide detailed information. They are not suitable for sharing technical information or

knowledge about policies related to plastic consumption. The second is related to policies and regulations and their enforcement (Koeng et al., 2020). When there is limited information on regulations and policies, people are more likely to be careless, which affects the control and management of plastic consumption (Edwards & Kellett, 2000). Often customers have limited technical knowledge of plastic bag usage.

This insight is reflected in the results of a study by (Hasan et al., 2015) who found that consumers generally access knowledge about the environment (e.g. plastic wastes pollutes the environment, impacts health, and kills marine life), which makes a significant contribution to the intention to reduce plastic consumption. However, customers often do not access technical knowledge about how plastic bags may impact their health. Plastic codes may be considered too technical to understand, which is why they are not widely understood by the public.

The study also supported findings that there are two important attitudes related to plastic consumption (Laroche et al., 2001). An attitude associated with the inconvenience of reducing plastic consumption is considered to be highly significant amongst consumers. Even though it is well-known that plastic bags pollute the environment and impact health, it is difficult (or inconvenient) to reduce plastic consumption. It was found that 29.5% of respondents (n=117) did not want to pay a fee to use a plastic bag. While they were active in sharing information about the impacts of plastic bags with relatives, friends, and other people, they did not take action where it is important. Chow et al., (2017) identified that while access to information,

knowledge, and attitudes lead to good practices; factors such as limited detailed information and an attitude of inconvenience leads to limited outcomes with respect to a reduction in plastic bag use among supermarket customers.

Customer practices and willingness to pay

The survey was conducted with highly educated participants (96.3% were university educated), however, the number of plastic bags used for each supermarket visit was high (between 1 and 7 bags). The factors leading to customers using plastic bags were their price (83%), convenience (95%), weight (96.8%), material (79.4%), and durability (61.8%). These findings confirmed those of (Verghese et al., 2006; Adane & Muleta, 2011). Consumers were also found to believe that plastic bags that contain the logos of reputable brands are desirable, hygienic and convenient.

The WTP for plastic bag use was found not to influence the number of plastic bags used. This suggests that Sub-Decree 138 was ineffective in deterring the use of plastic bags, despite a fee of 400 KHR (0.10 USD) being charged. Most customers had a higher WTP than the fee. Considering the results presented in Figure 6, the Royal Government of Cambodia should regulate an increase in the fee to 500 KHR (0.125 USD) to make it more effective in reducing plastic bag use among customers.

Factors influencing a reduction in plastic bag consumption

The factors influencing plastic reduction were indicated by the results of a Binary Logistic Regression $Wald\ Statistic\ \chi^2(26, n = 195) = 108$, P-value <0.001. Between 42% and 59% of the variance was shown to be

explained by 26 independent variables. This was supported by a Hosmer and Lemeshow Test which gave $Wald\ Statistic\ \chi^2(8, n = 195) = 6.2$, P-value >0.05 with (PAC=85.1%). These results show that access to information, attitudes, and good practices has a significant influence on reducing plastic bag consumption.

The impact factor associated with attitudes demonstrates the importance of the campaigns to raise public awareness. In this regard, campaigns are shown to be effective in transferring information and knowledge to customers. This result is similar to that of (Quicksand, 2015) who conducted campaigns to raise awareness on putting a larger number of items in a plastic bag. While attitudes were positive towards the importance of reducing plastic bag consumption, the inconvenience of reducing plastic bag use was still of concern to 57% of customers, who used alternative bags for supermarket visits.

Slogans were also found to be a factor in reducing plastic bag consumption. However, their impact was limited to spreading environmental knowledge and information to customers. For example, the slogan *plastic bag creates trash; impacts health; and pollutes water, land, and air*. More technical knowledge such as *reuse, reduce, recycle* and *waste management* requires knowledge transfer by other methods. Slogans are not well-suited to conveying detailed information in law and regulations. In this instance, methods such as television, radio, and social media platforms should be considered.

Good plastic use practices were also influencing factors in the reduction of plastic bag consumption. Applying plastic waste collection practices and charging a fee to use plastic bags was shown to influence consumer attitudes and behavior. The above activities persisted among supermarket customers and were shown to reduce plastic bag consumption.

Limitations

Two limitations affected the study. The first was missing data from respondents. As the survey was conducted at the supermarket gates, respondents considered the timing and environment of the survey to be inappropriate. As a result, only 239 respondents were analyzed in the one-way Anova test; while only 195 respondents were analyzed in the binary logistic regression out of a total of 403 surveys. In future studies, the time and location of the study should be considered more carefully. The second was the response rate of different consumer types. Applying a systematic sampling method of selecting every ninth customer resulted in an over-representation of students in the sample. Future studies should apply purposive sampling to remedy this issue (Dnscombe, 2014). In addition, the study should include an assessment of the significance of the behavior of sellers in influencing the use of plastic bags.

Conclusion

Based on the findings of this study, it is concluded that: limited access to information and a poor attitude towards the inconvenience of not using plastic bags has constrained the reduction of plastic bag consumption in Cambodian supermarkets. This has resulted in the high-level use of plastic

bags (1-7 supermarket visit). The WTP of government officers was found to be higher than that of students (321 KHR) and greater than that of other occupations (538 KHR). However, the difference between these different users and private employees was found not to be significant. The WTP of consumers 400 KHR was found to be significantly lower than the fee scheduled in Sub-decree 168. Despite this, the fee was shown not to influence the number of plastic bags they used. Thus, increasing the fee by 500 KHR is recommended as a further incentive to reduce plastic bag consumption in supermarkets. A binary logistic regression showed that access to information, attitudes, and practices were significant in influencing a reduction in plastic bag consumption.

In future studies, it is recommended that a research framework is designed to explore consumer awareness of the disadvantages of using plastic bag use, particularly those related to SDG-13 on Climate Action, SGD-14 on Life Below Water, and SDG-15 on Life on land. This study supports the conclusion of Ritch et al., (2009) that decoupling consumer behavior from the consumption of plastic bags required to achieve sustainable consumption, as a precursor to sustainable development. Policymakers should continue to encourage people who already use reusable bags, even if this has minimal impact on infrequent users (Rivers et al., 2017). Prospect theory demonstrates that perceptions in the changed of price may be influenced more by the frequency of their purchase, rather than the amount of expenditure. By this view, price increases may have a larger impact on perceptions than price decreases (Kahneman & Tversky, 2013). Thus,

policymakers in the Ministry of Environment and business owners play an important role in increasing the price of plastic bags. In 2008, this was demonstrated by the Chinese government, who introduced a nationwide regulation requiring all retailers to charge for plastic shopping bags to reduce plastic bag litter. Enforcement of this regulation has shown to impact consumer attitudes. The socioeconomic characteristics of consumers were also found to affected plastic bag consumption (He, 2012).

Acknowledgments

Biography

ING Kvanthai holds a Master of Development Studies; and a Bachelor of Economic Development from the Royal University of Phnom Penh. His research interests include environmental issues, poverty and debt management, and sustainable livelihoods.

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Appendix

Appendix 1. Independent variables included in the regression

Independent variables	Measurement	Value
Socioeconomic characteristic		
1. *Sex*	Nominal	Male=1, Female=2
2. *Age*	Numeric	Number
3. *Marital status*	Nominal	Married=1, widow=2, Single=3
4. *Education level*	Ordinal	Non education=1, Vocational training=2, Primary=3, Secondary=4, High school=5, University=6
5. *Household expenditure*	Numeric	USD ($)
6. *Year of residing in PP*	Numeric	Number
7. *Time of supermarket visit*	Numeric	Number
8. *Number of plastic bags used*	Numeric	Number
Knowledge		
9. *Plastic bags create an unclean living environment*	Nominal	Yes=1, No=0
10. *Plastic bags damage drainage systems*	Nominal	Yes=1, No=0
11. *Plastic bags impact health*	Nominal	Yes=1, No=0
12. *Plastic bags pollute water, land, and air*	Nominal	Yes=1, No=0
Attitudes		
13. *Education on the impacts of plastic bags is good?*	Nominal	Yes=1, No=0
14. *Plastic reduction campaigns will reduce plastic bag consumption?*	Nominal	Yes=1, No=0
Access to information		
15. *Through slogans?*	Nominal	Yes=1, No=0
16. *Through the media?*	Nominal	Yes=1, No=0
17. *Through leaflets?*	Nominal	Yes=1, No=0
18. *Through friends or relative?*	Nominal	Yes=1, No=0

19. *Through providing information to others?*	Nominal	Yes=1, No=0
Practices		
20. *Taking an alternative bag to the supermarket?*	Nominal	Yes=1, No=0
21. *Joining events or campaigns to collect plastic bags?*	Nominal	Yes=1, No=0
22. *Cooperating by using an alternative bag?*	Nominal	Yes=1, No=0
23. *Obeying the sub-decree?*	Nominal	Yes=1, No=0
24. *Paying to use a plastic bag?*	Nominal	Yes=1, No=0
25. *WTP for a plastic bag?*	Numeric	KHR
26. *Sorting wastes?*	Nominal	Yes=1, No=0

Appendix 2. Factors influencing a reduction in plastic bag consumption

Factor	B	S.E.	Wald	d.f	Sig.	Exp(B)
Socioeconomic characteristic						
1. *Sex*	-0.704	0.555	1.609	1	0.205	0.494
2. *Age*	-0.055	0.092	0.354	1	0.552	0.947
3. *Marital status*	-1.881	0.846	4.947	1	0.026	0.152
4. *Educational level*	-1.403	1.832	0.587	1	0.444	0.246
5. *Household expenditures*	0.001	0.003	0.112	1	0.738	1.001
6. *Years of residing in PP*	-0.138	0.038	12.920	1	0.000	0.871
7. *Time of purchase*	0.268	0.152	3.092	1	0.079	1.307
8. *Number of plastic bags used*	0.066	0.551	0.014	1	0.904	1.069
Knowledge						
9. *Plastic bags create an unclean living environment*	0.596	1.532	0.151	1	0.697	1.815
10. *Plastic bags damage drainage systems*	20.225	40192	0.000	1	1.000	60786
11. *Plastic bags impacts health*	1.472	1.109	1.763	1	0.184	4.359
12. *Plastic bags pollute water, land, and air*	0.237	0.653	0.132	1	0.716	1.268
Attitudes						

13. Education on the impacts of plastic bags is good?	1.502	1.245	1.454	1	0.228	4.489
14. Plastic reduction campaigns will reduce plastic bag consumption?	2.367	0.869	7.410	1	0.006	10.662
Access to Information						
15. Through slogans?	1.695	0.625	7.365	1	0.007	5.446
16. Through the media?	-1.377	0.721	3.650	1	0.056	0.252
17. Through leaflets?	1.037	0.586	3.133	1	0.077	2.822
18. Through friends or relative?	-1.428	0.693	4.251	1	0.039	0.240
19. Through providing information to others?	-0.006	0.565	0.000	1	0.992	0.994
Practices						
20. Taking an alternative bag to the supermarket?	-1.322	0.595	4.933	1	0.026	0.267
21. Joining events or campaigns to collect plastic bags?	1.537	0.613	6.294	1	0.012	4.650
22. Cooperating by using an alternative bag?	1.589	2.403	0.437	1	0.508	4.899
23. Obeying the sub-decree?	2.012	0.848	5.627	1	0.018	7.482
24. Paying to use a plastic bag?	0.222	0.513	0.188	1	0.664	1.249
25. WTP for a plastic bag?	-0.001	0.001	1.129	1	0.288	0.999
26. Sorting wastes?	0.728	0.476	2.345	1	0.126	2.072
Constant	-12.60	40192	0.000	1	1.000	0.000

Vulnerability to changing climate: Locating smallholder farmers coping strategies in drought-prone districts of Cambodia and Nigeria

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សេចក្ដីសង្ខេប

យើងបានស្វែងយល់អំពីរបៀបទប់ទល់នឹងការប្រែប្រួលអាកាសធាតុដែលបណ្ដាលមក ពីការឡើងកំដៅខ្លាំងរបស់កសិករមានដីស្រែតិចតួចនៅតំបន់រាំងស្ងួតក្នុងស្រុកគាស់ក្រឡ ខេត្តបាត់ដំបង ប្រទេសកម្ពុជា និងស្រុកអ៊ីនគូរូ (Nguru) រដ្ឋយ៉ូបេ (Yobe) ប្រទេស នីហ្សេរីយ៉ា (Nigeria)។ ពត៌មានដែលត្រូវការសម្រាប់ការសិក្សានេះត្រូវបានប្រមូល តាមរយៈការសម្ភាសបែបស៊ីជម្រៅ ការពិភាក្សាជាក្រុម ដោយធ្វើជាមួយកសិកសំខាន់ៗ នៅកម្ពុជា ចំនួន៧០ខ្នងផ្ទះ និងនៅនីហ្សេរីយ៉ា ចំនួន១១៦ខ្នងផ្ទះ។ ការសិក្សាបាន គូសបញ្ជាក់ពីឧបស័គ្គក្នុងការធ្វើយតបទៅនឹងការប្រែប្រួលអាកាសធាតុរបស់សហគមន៍ ដែលត្រូវបានជ្រើសរើសសម្រាប់ការសិក្សា។ ការសិក្សាបង្ហាញថា គ្រួសារដែលសមាជិក មានការងារជាក់លាក់ដូចជាធ្វើការអោយគេ ឬធ្វើសិប្បកម្ម ដែលផ្ដល់ប្រាក់ចំណូលដល់ គ្រួសារ ច្រើនតែងគ្រោះតិចជាងគ្រួសារដែលមានសមាជិកធ្វើការរយៈពេលខ្លីៗ។ លទ្ធផល របស់យើងបង្ហាញថា គ្រួសារភាគច្រើនមានជម្រើសតិចតួចក្នុងការប្រកបការងារដោយសារ ខ្វះជំនាញ ខ្វះដើមទុន និងខ្វះកម្លាំងពលកម្ម។ មួយបំណែកនៃការខ្វះជម្រើសការងារនេះ

គឺបណ្ដាលមកពីស្ថានភាពយេនឌ័រមានសភាពខុសៗគ្នា ទាំងគ្គនាទី ទាំងការទទួល ខុសត្រូវ និងទាំងសមត្ថភាព ដែលនាំឱ្យស្ត្រីត្រូវបានដាត់ចេញពីការបំពេញការងារវែល ខ្លួនពេញចិត្តខ្លាំងៗ។ ផ្អែកលើលទ្ធផលនៃការវិភាគនេះ៖ មានការផ្ដល់អនុសាសន៍ផ្សេងៗ ទាក់ទងនឹងផ្អែកគោលនយោបាយ។

Abstract

We investigate how smallholder farmers in drought-prone Koas Krala district, Battambang Province, Cambodia and Nguru district, Yobe State, Nigeria cope with climate stress resulting from the impacts of climate variability and extremes due to drought. Information was collected for this study through a survey of 70 and 116 farm households, in-depth interviews, focus group discussions, and key informant interviews in the respective districts in Cambodia and Nigeria. The study highlights the constraints faced by the selected communities in responding to climate change. The study reveals that households where an individual can take on one specialized activity, such as employment or handicrafts, in the context of overall diversification of household income, were often less vulnerable than households where each individual is engaged in many activities at low intensity. In practical terms, our results suggest that many households have limited access to their favored coping practices due to a lack of skills, capital and/or labor. This lack of access is compounded by gender differences in roles, responsibilities and capabilities that have led to exclusion of women from carrying out these activities with sufficient intensity. Based on this analysis, policy recommendations have been suggested.

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Keywords: adaptation, vulnerability, coping strategies, climate change, Cambodia, Nigeria

Introduction

Vulnerability is a key term in the climate change literature that has been subject to various interpretations and uses. Although a variety of definitions has been proposed, a comprehensive description suggests that vulnerability is *"a state of susceptibility to harm from exposure to stresses associated with environmental and social change and the absence of capacity to adapt"* (Adger, 2006). Several scholars in recent climate change literature further suggest separating vulnerability into physical and social elements (Adger, 2006; Brooks, 2003; Gebreyes & Theodory, 2018), whereby the former refers to exposure to stress and crises resulting from physical hazards, and the latter refers to the capacity of individuals and communities to respond to

physical impacts (Eriksen et al., 2005; Adger et al., 2001; Smit & Wandel, 2006).

Discussion in the literature identifies three components of climate vulnerability: exposure, sensitivity, and the capacity to adapt. Coping strategies are subsumed under the definition of the last of these components, adaptability. However, coping and adapting are considered two distinct processes, with different timescales (Eriksen et al., 2005). Coping is defined as an array of short-term strategies adopted in response to a crisis. The aim of coping is to maintain various objectives of a household, including livelihood security, consumption, health and status, thus ensuring individual and/or collective well-being. On the other hand, adaptation generally refers to long-term change based on livelihoods that serve to reduce future vulnerability to climate stress (Adger, 2006; Adger et al., 2001; Smit & Wandel, 2006). The two processes are intrinsically linked. The strengthening of coping strategies acts as a means of facilitating adaptation (Eriksen et al., 2005).

Climate change is one of the major challenges facing all categories of farmers globally in multifaceted ways due to its impact on agricultural yield and food security in the developing world, which require adaptation strategies. Agricultural production is particularly vulnerable to climate change in tropical Africa due to the impact of climate shocks such as heatwaves, erratic rainfall, and prolonged drought (IPCC, 2014). Water scarcity is a major dilemma for food production and sustainable development (Alemayehu & Bewket, 2017) as it affects smallholder farmers

in tropical Africa and Asia, whose agricultural production is reliant on rain-fed irrigation (Alemayehu & Bewket, 2017). Food insecurity is then caused by changes in rainfall and increased temperatures, which bring about prolonged dry spells that place stress on farming systems (Domenech, 2015).

It is difficult to provide a precise and universally accepted definition of drought due to its varying characteristics and impacts across different regions of the world on rainfall patterns and the way humans respond. However, drought is the interval of time during that rainfall at a given place consistently falls short of what is climatically expected. Conditions of drought appear when rainfall is deficient compared to the statistical multi-year average for a region, over an extended period (Ishaya & Abaje, 2008; Ayanlade, 2017). In this paper, we focus on meteorological droughts, which are based on the degree of dryness or rainfall deficit, and the length of the dry period.

Although Cambodia and Nigeria are separated by an enormous distance, both lie in the tropics. Despite the dominant role of commodities (Cambodia) and petroleum (Nigeria) in foreign exchange earnings, agriculture plays a significant role in each countries national economy. For instance, in 2018 in Cambodia, the agricultural sector contributed about 26.6% of the GDP and employed about 43% of the total labour force. Most people involved in agriculture are smallholder farmers with less than two hectares per household. The area of land under cultivation is 3.7 million hectares, 75% of which is assigned to rice production. Rice is the country's main crop and consequently the main source of income for most farmers. Industrial crops,

such as rubber and other food crops represent the remaining 25% of agricultural land use (Syngenta, 2018). Similarly, in 2017 in Nigeria, agriculture contributed about 21% of GDP and employed 67% of the labour force (IFAD, 2018). The agricultural sector in both countries is threatened by climate variability (UNDP, 2011).

Furthermore, each country is undergoing rapid population growth (1.7% per annum in Cambodia and 2.3% per annum in Nigeria) and possess a very young population, with about two-thirds of the population under 25 years of age (16.5 million people in Cambodia; and 178 million people in Nigeria). The per capita income of each country (1,269 USD in Cambodia; and 2,222 USD in Nigeria) sees both countries listed as lower-middle-income countries (World Bank, 2020). Besides, both countries are endowed with fragile natural resources, where a large proportion of the population are susceptible to natural hazards such as droughts, floods and sea-level rise (Norm, 2009; Ishaya & Abaje, 2008; Ayanlade, 2017).

The districts of Koas Krala in Battambang Province, Cambodia and Nguru in Yobe State, Nigeria have faced recurrent droughts for decades, with a magnitude and intensity that appear to be increasing (Norm, 2009; Mortimore, 2010). Hence, farmers in these districts have used coping strategies, or short-term responses to overcome immediate threats and manage unfavourable weather conditions. For this study, we consider coping strategies to be activities undertaken by households aimed at obtaining food or income during times of stress, either through production or through formal and informal means of exchange.

In this paper, we consider how smallholder farmers in drought-prone districts in Cambodia and Nigeria cope with climate stress and draw out the implications associated with the vulnerability of these farm households. We also consider how climate vulnerability might be reduced. In assessing household capacity to respond to drought, we examined the consequences of the short-term, seasonal droughts of 2004 in Koas Krala; and in 2008 in Nguru to access direct and experiential evidence of these strategies. These represent the worst drought years in recent times in each respective study area. Finally, we consider the implications of the process of adaptation and the policies that might facilitate adaptive management. Therefore, the findings of this study may provide smallholder farmers with an enhanced capacity to plan coping and adaptation strategies and improve crop production.

Conceptualizing vulnerability to climate change

Climate change is defined as *"any change in climate over time, whether due to natural variability or as a result of human activity''* (IPCC 2014), or by an enlarged definition as *"a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable periods"* (IPCC, 2014). Extreme temperatures, floods, droughts and water scarcity are expected as a result of climate change due to anthropogenic activities that lead to increased GHGs emission, as well as lower levels of precipitation. This reduces the availability of food resource needed for community livelihoods. Climate variability is expected to severely affect

agriculture across the globe. Global warming scenarios suggest that impacts may include increasing temperatures and declining rainfall, consequently reducing crop yields and quality, while increasing food insecurity.

Over the past few decades, tropical countries have been observed to be the most exposed regions to the impacts of climate change (IPCC, 2014; Niang et al., 2014). The World Bank (2013) has reported that around 64% of the labour force in developing countries in Africa and Asia are employed in the agricultural sector. Moreover, since 2000, agricultural activities have increased. Smallholder farmers in the tropics already face significant threats to agricultural production, while extreme changes to the climate are projected to have an even greater adverse effect on farmers, placing further risks on their livelihoods. Empirical studies indicate that smallholder farmers tend to be more susceptible to climatic impacts because of an over-reliance on rain-fed irrigation. Increased attention is being focused on tropical Africa and Asia due to increased vulnerability to climate stressors. There have been few studies conducted in developing countries that have analysed the role national and local governments can play in setting policies that promote adaptive strategies in response to a changing climate.

Adaptation is defined as an *"adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderate harm or exploits beneficial opportunities"* (IPCC, 2007; UNFCCC, 2013). The term *"adaptation"*, includes financial, socio-economic and institutional changes. Hence, adaptation to climate change involves a comprehensive set of activities by which a population responds according to

various climate pressures (Menike & Arachchi, 2016; Nyong et al., 2007). Such responses refer to systematic environmental, social and/or economic adjustments (Komba & Muchapondwa, 2015; IPCC 2014). Therefore, climate change adaptation is considered as *"a process by which individuals and communities alter regular activities to deal with climate change stimuli, irrespective of their intent, or spatial and temporal performance"* (Komba & Muchapondwa, 2015;).

In Africa and Asia, most smallholder farmers depend on farming activities for their livelihood, food security, and resilience (Garcia de Jalon et al., 2018; Hou et al., 2015). Hence, these farmers are sensitive to variations in climate, particularly precipitation and temperature (Atedhor, 2019; FAO, 2008). Agricultural production in this context is characterized by low crop yields, because of prolonged drought, variable precipitation, heatwaves, and high temperatures (Maponya & Mpandeli, 2013). However, Uddin et al. (2017) report that addressing climate variability issues has in recent decades placed more emphasis on minimizing the release of greenhouse gases. Nonetheless, minimal progress has been made in this regard, whilst climate change has persisted in having negative impacts on agricultural production in various nations in Sub-Saharan Africa. As a result, attention has shifted from halting greenhouse emissions to adaptation strategies that minimize vulnerability to the impacts of a changing climate (UNFCCC, 2013).

Adaptation to climate change is not a new phenomenon within developing countries, where it has been a common focus in recent years due to the context of climate variability (Mubiru et al., 2015; Burton et al., 2006).

However, at the commencement of the United Nations Framework Convention on Climate Change (UNFCCC), mitigation was employed as a primary strategy to deal with the climate dilemma. Since that time, it has been recognized that policy responses focus on mitigation alone, cannot address climate change. Thus, adaptation has now been placed on an equal footing with mitigation (Mubiru et al., 2015; Hill, 2008). The concept of adaptation recently evolved into a research area that is influential in many fields of study (Perego, 2019; Van Aalst et al., 2008). It has become an imperative policy response to the negative effects of climate change alongside mitigation (Burton et al., 2006; Devi et al., 2017).

Further, the concept of adaptive capacity is closely related to many other common terms such as coping ability, adaptability, robustness, flexibility and resilience (Jianjun et al., 2015). Its definition varies from the local community to community, from individual farmer to farmer. This variation is dependent on its contextual nature and value in any particular environment. The magnitude of adaptation is dependent on the ability of a farming household to respond to climate shocks and over the short term, the level of support from the community or environment (Smit & Wandel, 2006; Adegnandjou et al., 2018). The capacity for local farmers to adapt may be affected by such factors such as farm size, access to information and financial resources, availability of technology and infrastructure, institutional settings and political will, and the environment in which adaptation occurs (Adger et al., 2001; Smit & Wandel, 2006; Ayanlade et al., 2017; Mkonda et al., 2018). The objective of this study is to investigate the negative impacts of climate

change on the activities of small-scale farmers and how they determine the choice of adaptation strategy.

Research Methodology

The two study districts selected for this study are located in areas that are affected by drought and climate change, where subsistence mixed farming is a major means of household livelihood. Koas Krala is situated in Battambang Province, Western Cambodia (Figure 1). While, Nguru district is situated in Yobe State, Northeastern Nigeria (Figure 2). The characteristics of each district are summarized in Table 1. As in any agrarian community, access to land is of crucial importance. However, in both districts, new allotments of farming plots are becoming increasingly rare. It is almost impossible to find virgin arable land surrounding villages in these areas (Norm, 2009; Mortimore, 2010).

There is also great inter-household variation in the size of landholdings, with the majority of farmers owning lands under an inheritance system. In the case of Koas Krala, inheritance is matrilineal, while in Nguru it is patrilineal. Drought is the most impactful climate hazards in these districts and the livelihoods of the communities within them have evolved under variable climatic conditions over time (Norm, 2009; Yila, 2013; Mortimore, 2010).

Results from the normalized rainfall index in each study area are also presented in Figure 3 and Figure 4 for Koas Krala and Nguru, respectively. These graphs show that both study areas have experienced ongoing mild to severe drought events over time. For instance, in Koas Krala, severe drought

conditions occurred in 1987, 1990, 1991, 1993, 1994, 2002, 2004, 2010 and 2013; moderate droughts conditions occurred in 1997 and 2017; while mild drought conditions occurred in 2006 and 2015 (Figure 3).

Figure 1. Koas Krala District, Cambodia **Figure 2.** Nguru District, Nigeria
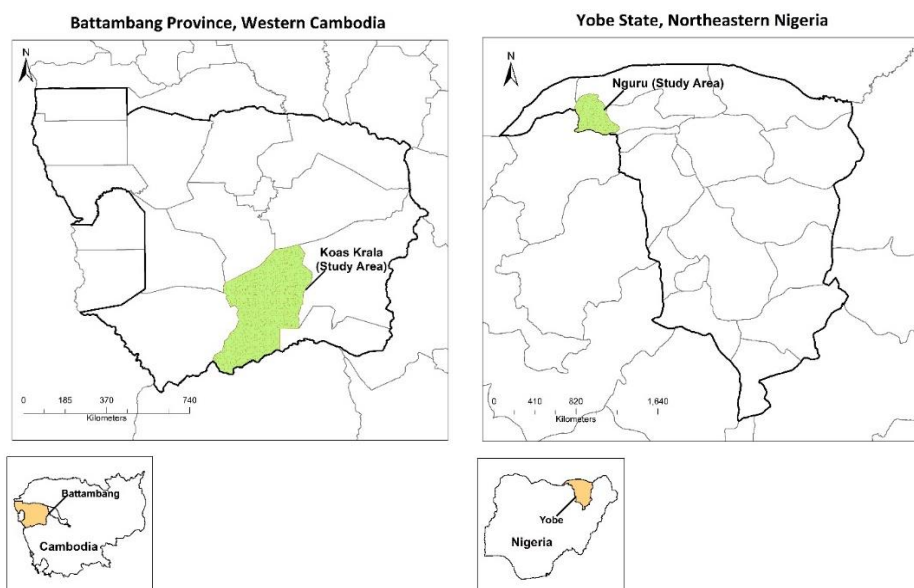
In Nguru District severe droughts occurred in 1987, 1989, 1991, 1993, 2000, 2004, and 2008; moderate droughts occurred in 2009, 2011, 2015 and 2017; while mild droughts occurred in 1995 and 2013 (Figure 4). Though droughts have often caused local food shortages, there have also been other factors in play, such as social unrest and floods (Norm, 2009; Mortimore, 2010). To ensure food security and overall well-being, these communities have depended upon adaptation via multiple coping strategies deployed in response to changing conditions. Men and women have each played key roles in the process of diversifying local livelihoods to contribute to food security at the household level.

Data were collected between October 2008 and February 2009 in Koas Krala and December 2010 and April 2011 in Nguru. This data was supplemented with new data collected in July 2019 in Koas Krala and August 2019 in Nguru, as well as secondary data from other research.

Table 1. Key characteristics of each study district

Characteristic	Factor	Koas Krala, Cambodia	Nguru, Nigeria
Demographic	Population	68,876	159,632
	Household size	5.2	6.6
Economic	Average land size per household	4.2 ha	3.2 ha
	Major crops	Rice, red corn, soya bean, cassava, peanut, sesame, sweet potato, mixed vegetable	Millet, sorghum, maize, cowpea, sesame, and groundnuts
Climatic	Average annual rainfall	1150 mm	557 mm
	Average annual temperature	31°C	32°C
	Altitude	45 m	327 m

Source: Reviews, August 2020

A range of techniques was employed to generate information and triangulate insights to build a progressively more detailed picture of the conditions of vulnerability and the coping strategies employed by households. These included focus groups discussions, semi-structured interviews, open-ended discussions, key informant interviews, and household questionnaires (Table 2).

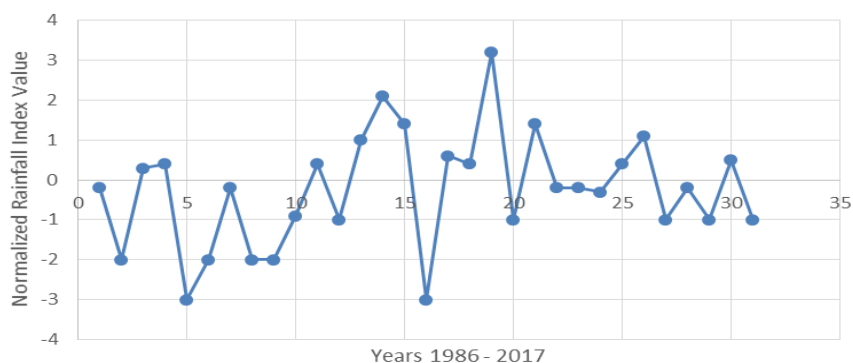**Figure 3.** Normalized rainfall index for Koas Krala, Cambodia

Figure 4. Normalized rainfall index for Nguru station, Cambodia
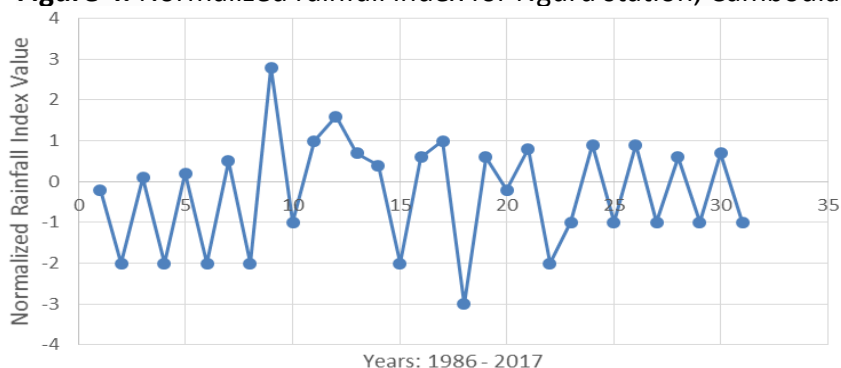
Source: Nigerian Meteorological Agency Abuja, August 2020.

A two-stage sampling process was applied to select the farmers for the survey. Initially, Koas Krala and Nguru were purposively selected as historically drought-prone districts that have a high dependence on rain-fed agriculture and as a result include farmers with a long-term experience on which to draw form. Then, in consultation with local project partners, four villages from each district were selected to sample from. Factors considered in selecting the study villages included the past occurrence of repeated drought, the size of the village and the willingness of the women to

participate in the survey. All villages were within 5 to 10 kilometres of the district headquarters. The sample sizes in each village were determined proportionately to the total number of households (Table 3).

Table 2. Sample size by surveyed village and district

District	Study villages	Sample size	Total
Koas Krala, Cambodia	Chhnal Moan	16	70
	Krang Svat	20	
	Banteay Char	15	
	Samraong	19	
Nguru, Nigeria	Konkon	25	116
	Musari	42	
	Balewa	23	
	Dudiri	26	
Total			186

A list of the households in each village was obtained from the village head, with households numbered from 1...n. Every third household was selected for an interview. The interviews were conducted at each respective houses. When households were found unoccupied, a return visit to conduct the survey was completed the following day. The heads of the households were interviewed in their role in making decisions about farming activities and household coping strategies. Table 3 summarizes the primary data collection strategy. Relevant secondary data available from scientific reports, maps and statistical abstracts were also used to supplement this data.

Results and Findings
Farmers' perceptions of droughts and climate change
Choosing coping strategies in response to drought is a two-step process. First, the farmers perceive the occurrence of drought, then they act to apply

a strategy (Mortimore, 2010). The perception of drought is thus a prerequisite for the initiation of a coping strategy. Studies reveal that a majority of farmers already perceive drought as a recurring feature of their environment (Mortimore, 2010; Mertz et al., 2009; Deressa et al., 2009). Almost all farmers in each study area, 93% of respondents in Koas Krala and 95% in Nguru regard drought as the interval of time during which rainfall at a given place fell consistently short of what was expected (the remaining respondents did not provide an explanation). Further, 54% of farmers in Koas Krala and 56% in Nguru distinguished drought as a prolonged period of at least two seasons without precipitation. For the farmers in these districts, 'duration' was an important factor in defining drought, consistent with an agro-ecological definition.

The frequency of drought changes the decision frameworks for farmers and can influence households coping strategies and actions. Among the respondents, 68.1% of households in Koas Krala and 74.8% in Nguru perceive that drought is becoming more frequent. Worthy of note is that a small percentage (3.1% in Koas Krala and 1.7% in Nguru) perceive drought as becoming less frequent (Table 4). The response is consistent with the drought incidence in these two areas, as the incidence of drought is greater in Nguru due to its semi-arid environment.

Long-term temperature and precipitation changes, as well as the wind, are key parameters related to climate change in each study district. The perception of these climate parameters was assessed at the household level (Table 5). The surveyed households were asked questions about their

understanding and observations in the patterns of temperature, rainfall and wind over the past 20 years.

Table 4. Perception of drought frequency*

Response	Koas Krala n=70 (%)	Nguru (n=116) (%)
Becoming more frequent	68.1	74.8
No change	20.5	16.5
Becoming less frequent	3.1	1.7
Don't know	6.4	7.0

* Percentage of farmers from each district. Differences between districts are significant at chi-square 0.001 level

The majority of the farmers (86% in Koas Krala and 84% in Nguru) perceive the temperature to be increasing, thus, farmers' perceptions corroborate with the statistical records in the study area. According to Norm (2009), the average maximum temperature in Koas Krala has been rising, from a baseline of 32^0C in 1982 to an average of 34-35^0C in recent years (Fig. 3). The data between 1901 and 2005 for Nguru also shows an increasing trend (Figure 4).

The overall perception of long-term changes in precipitation is that both districts are getting drier and that there are pronounced changes in the timing and frequency of drought vents. The majority of respondents revealed that rainfall has become highly unpredictable in recent years and that the onset and amount of seasonal rainfall are erratic. The prevalence of mid-season dry spells was also reported to have increased. Recorded annual rainfall data between 1982 and 2008 for Koas Krala reveals irregular rainfall conditions for the past 27 years. The last heavy annual rainfall event was

recorded in 1999 (1,500 mm). Outside of this outlier, annual rainfall has ranged between 1,000mm and 1,200 mm, with the lowest level recorded in 2004 (Fig. 3). Nguru district recorded a significant decline in annual rainfall between 1934 and 2005, with an average reduction of 8mm per year (Figure 4). This is consistent with the survey, where 88% of farmers reported a decrease in precipitation.

The information collected during the focus group discussions generally corroborated with the household surveys. Respondents expressed concern about increasing dry and wet season wind speeds (Table 5). However, the nuanced opinions on rainfall trend expressed in the household surveys, where there was agreement on the declining and negative trend in rainfall were not verified in the focus group discussions.

An overall analysis of perceptions shows that farmers in each district have a quite elaborate knowledge of climate-related factors and that most farmers are aware of the fact that temperatures are increasing and the level of precipitation is decreasing. In the focus groups, female respondents were more animated in their concern about climate change compared to male respondents. One key finding that emerged was that all farmers reported changes in climate variability over the past twenty years. These perceptions could be confirmed with records that indicate that the two districts have a history of worsening drought conditions. Male and female farmers both reported similar or identical observations of temperature and rainfall trends over time. This demonstrates that memories of historical climate trends can be a useful resource for understanding historical climatic trends.

Nevertheless, additional research is needed to confirm whether there is a difference in farmer perceptions of climatic trends and records over different timescales

Strategies for coping with drought

In both districts, farmers were found to practice a variety of coping strategies that are representative of their different capacities to manage risk and take advantage of new opportunities in the agricultural sectors of each country. Most respondents identified autonomously (implemented without external intervention) and responsive (implemented in reaction to climatic events and impacts) strategies. These strategies have been categorized into past and present mechanisms. Past coping strategies are those adopted before the extreme droughts that occurred in 2004 in Koas Krala and 2008 in Nguru, while present strategies are those that occurred after these drought events (Table 5). It should be noted that past and present coping strategies are not mutually exclusive, as a respondent may have adopted a strategy in the past that they still use now.

We found that coping strategies are not fixed or generic across different households, rather they vary according to the particular exogenous and endogenous context of each household. Understanding how these factors are shaped by the interaction of different processes is key to understanding the changing patterns of vulnerability within a community and across a region (Eriksen et al., 2005). Exogenous factors are those factors that shape coping options but are largely beyond the control of communities and households. These include local economic and political factors, as well as

local climate and ecology, culture and infrastructure. Factors endogenous to the household include demographic and socio-economic characteristics.

Table 5. Coping strategies identified by respondents

Strategy	Past		Present	
	Koas Krala (n= 70)	Nguru (n=116)	Koas Krala (n= 70)	Nguru (n= 116)
Drought resistant varieties	23	26	20	22
Crop diversification	32	29	34	31
Livestock diversification	15	12	13	15
Mixed cropping	71	78	82	84
Early maturing crop varieties	24	19	22	21
High yield varieties	12	18	18	20
Replanting	14	12	8	10
Taking waged labour	27	23	33	34
Labor migration	25	31	32	36
Selling productive assets (livestock and agricultural products	16	19	22	21
Farm relocation	3	2	1	1
Food storage	45	47	34	38
Seed banks	11	9	7	6
Share cropping	8	6	5	5
Diversifying household income	33	29	38	34
Irrigation	8	7	16	7
Mortgaging land	4	3	6	3
Taking loans	8	11	13	15

Food storage, diversification of family income, crop diversification, taking waged labour, labour migration, as well as selecting high yielding and/or drought-resistant varieties are popular coping strategies in each district. Among these strategies, food storage is the most popular past coping

strategy. However, more recently, the number of people using food storage strategy has declined. The likely reason for this is that most households have had insufficient food even in good years to enable them to store food as a hedge against drought.

Other strategies that have declined in use include the replanting of crops, cultivation of drought-resistant varieties, and seed banks, Most of the farmers (93%) mentioned that benefits from these strategies are less than what was expected, or that the costs of inputs needed to implement them, such as chemical fertilizers and fuel to operate pumping machines are beyond the reach of their household. To reduce the possible risk of food shortages arising from uncertain rainfall, farmers perceive that they have no other option but to intensify waged labour, labour migration and diversified income strategies to minimize risks. In particular, respondents mentioned that labour migration serves as a safety valve in a situation where there are multiple uncertainties. In years where there is normal rainfall, this strategy helps them to increase their income by making efficient use of what is produced. Even though gaining a maximum return on their labour is perceived as important, the ultimate goal of respondents was reported as achieving stable production and food security. This shift in strategies is evidence that respondents are willing to change and adopt new coping strategies.

There was significant evidence generated that existing gender roles act as constraints to adopting some coping strategies. For instance, in Konkon village in Nguru district, Hadiza, who is a widowed household head, cares for

three school-aged children. She previously grew vegetables for sale, however, declining rainfall in recent years has constrained her activity as she cannot afford the cost of diesel to pump water for irrigation. Combined with the loss of income from her husband, this has placed her household in a precarious situation and she now relies upon her mother conducting petty trade to buy food. In the same village, a man named Hamisu abandoned farming due to several seasons of low rainfall. He was able to find employment in a local tanning factory and is now able to support his family. For Hadiza, such an option would be much more difficult, partly because she only has a primary school education, but also because she needs to stay close to the household to care for her children.

In Koas Krala district, prolonged drought has had a significant impact on rain-fed rice cultivation. Farmers now rarely transplant seedlings from seedbeds as they did in the past when rainfall was regular. Instead, many have turned to direct sowing. Further, they have abandoned the practice of cultivating a second crop during the rainy season to ensure adequate rice supply for achieving a surplus for sale at the market as this is no longer tenable. To redress this shortfall, many men have diversified into collecting fuelwood for charcoal production and other non-timber forest products. Others have turned to driving motorcycle taxis or taking waged labour. A sizeable number now regularly migrate to Thailand to work in the construction industry. Many women have taken to waged labour, while some are involved in raising livestock, brewing local beer and supporting their husbands work in charcoal production.

Farmers access to institutional support

Cambodia and Nigeria have both recently undergone political and institutional change. Although households can make decisions that reduce their vulnerability to climate change and drought, these decisions are embedded in the institutional framework. Until 1979, Cambodia was led by the brutal and repressive Khmer Rouge regime, while in Nigeria democracy returned after a long period of military rule in 1999. Before this, traditional governance systems prevailed, based on communal authority in both countries. Local-level institutions and collective action based on social capital were the main mechanisms for responding to livelihood risks. Since these changes, households in Koas Krala and Nguru have had access to democratic governance structures and associated policy frameworks, and a wide variety of institutions now influence livelihood decisions in these contexts. This has had implications for vulnerability to drought, as decisions at the household level are now embedded within a new framework, within a landscape that can intentionally or otherwise influence local coping strategies.

In response to increasing vulnerability, external policies and institutional interventions have become more prevalent in relieving communities of droughts impacts. Farmers are prompt to point out that many of these measures are reactive and often lack foresight. The concerns expressed are many interventions have further weakened the coping capacity of communities. In some cases, measures have been identified as constraints to community-level innovation in coping strategies and have exacerbated inequalities. Much less than one-quarter of respondents in each district

reported receiving assistance (information, training, and materials) from government institutions. This result was found to be significantly gendered, with 23% of men and only 9% of women receiving institutional support.

Whilst access to the new policy frameworks within new democratic governance structures is often intended to be equal, in reality, this is often not the case. Policies at the national level are directly and indirectly aimed at reducing absolute vulnerability to climate change and drought. However, local-level implementation is variable, and access to policy frameworks differs between households heads based on differences in both human (education) and social capital. Overall, men are better informed and have access to wider networks through which knowledge can be dispersed. Thus, male-headed households tend to have greater access to opportunities afforded through new policies and institutions. The result is creating differential levels of vulnerability, where male-headed can apply coping strategies that are supported by institutional structures, while female-headed households are still largely dependent on traditional governance structures and informal institutions when responding to climate risks.

Discussion
Adaptation and coping strategies applied in response to climate change at the farm level

Farmers in Koas Krala and Nguru have had to adopt different strategies to respond to climate change in light of farming being the primary occupation of the majority of the local community. Based on survey data collected from 186 smallholder farmers, supplemented by semi-structured interviews, and focus-group discussions, perceptions on climate change of

respondents have been analysed to better understand coping and adaptation strategies. This is important as smallholder farmers face precarious futures due to climate change and this call for innovative livelihood strategies. The situation is even more acute for marginalized smallholder farmers in Nguru District, Nigeria. For the near future, the farmers in these two case studies have no other option but to cope with, or ideally, adapt to a changing climate.

Across each district, most smallholder farmers attributed reductions in crop yields to changing precipitation patterns and rising temperatures. Although the perceived impacts varied in each district, the magnitude of climate change impacts was found to have become more significant over the past two decades. The most commonly observed changes include an increase in temperature (94% of respondents); low rainfall (92%); rainfall variability (93%) and an increased recurrence of drought (71.5%). Most respondents reported altering their farming practices to minimize their vulnerability and/or to adjust to the changing weather conditions in response. These coping strategies include diversifying crops and planting new crop varieties. The findings show that farmer perceptions about climate change have had an impact on their livelihoods, as they have been the basis for decisions made in response (Yila & Resurreccion, 2013). Findings from similar studies have also concluded that perceived changes in their local climatic conditions are a significant driver in the implementation of various coping and adaptive measures.

Table 6 demonstrates that out of the 186 farmers surveyed at the two research sites, 19% have used improved seeds (hybrid) or diversified to new crops, as a climate change adaptation strategy over the past two decades. Similar findings were highlighted in a study conducted in Sri Lanka by Gunathilaka et al. (2018). Also, 21.5% of participants agreed that cultivation of early maturing crop varieties makes up for decreased household food sources; 74.5% claimed to have adopted cultivation over shorter cycles; 78.6% of households have adopted more drought-tolerant crop varieties; while 78.5% have delayed planting some crops until later in the season. Similar studies by Epule et al. (2017) have shown that changing crop planting dates is employed as a climate change adaptation strategy in the Sahel region as a result of prolonged dry spells.

Higher yielding crop varieties

Another result from the study demonstrates that smallholder households have adapted to climate shocks, such as heatwaves, prolonged dry spells, drought, declining rainfall, and temperature increases by applying shorter cycle cropping with hybrid seeds and abandoning indigenous crops. The focus group discussions discovered that over the last 20 years farmers have slowly transitioned from growing traditional rice, maize, and bean varieties due to declining yields and increased impacts from pests and diseases. This is consistent with a similar study by Setimela & Kosina (2006), who confirmed that respondents in South Africa now select open-pollinated varieties (OVPs), such as Zm521 (maize) as it enables comparatively more stable production, early maturity, and greater resistance to drought. It is also supported by the

findings of Dedewrwaerdere & Hannachi (2019) in Yunnan Province, China who examined the socio-economic factors related to the co-existence of landraces and modern crop varieties; as well as findings by Gunathilaka et al. (2018), who studied the barriers and policy implications of climate adaptation approaches in perennial cropping systems in Sri Lanka.

Despite differences in the perceptions and awareness of smallholder farmers about climate challenges at each research site, the focus group discussions and interviews held with the extension workers and farmers revealed that adaptation strategies are similar in both Nigeria and Cambodia. However, it was of paramount interest to this study to assess in-depth data about differences in the adaptation and coping strategies from one area to another. Farmers at each site all adopted coping strategies that focused on changing the crop varieties with high yield potentials. The preference for high yielding varieties cut across all typologies of farmers despite differences in the types of crops cultivated in each village. For example, in Nguru, farmers preferred crops including maize, groundnut, sweet potatoes, rice, beans, and tomatoes. The survey results indicate that 56.8% of farmers selected hybrid maize varieties, with an improved yield to replace open-pollinated maize varieties (Table 6). Farmers in Musari village replaced maize crops with beans, sweet potatoes, and hybrid sorghum. In Dudiri village, others have identified sesame and improved maize as higher-yielding crops. While in Konkon village, smallholder farmers have reported that rice and onions have higher-yielding potential.

Further, extension officials reported that for smallholder farmers to accept new cultivars that they must first demonstrate higher yields than traditional varieties in support of farmer preferences for crops that achieve higher prices at the market (Dedewrwaerdere & Hannachi, 2019). Higher market prices have been shown to influence smallholder farmer decisions on the crop variety to plant. It is therefore important to understand that low crop varieties have low-income returns and this affects the livelihoods of the majority of smallholder farmers in Koas Krala and Nguru districts. This finding agrees with the results of a study conducted by Perego (2019) analyzing crop prices and land titles in Uganda, where crop prices had a strong influence on when smallholder farmer had access to a marketplace.

Changing planting dates using shortened crop cycle varieties

The majority of smallholder farmers were found to cultivate shorter-cycle crop varieties to adapt to uncertain climatic conditions, especially when they are not able to access climate advisory information. This strategy was employed by farmers in Musari, Balewa, and Banteay Char, where there is seasonal rainfall variability. In these instances, farmers have adopted crop varieties with shorter cycles as part of a climate change adaptation strategy. Continuously changing climatic conditions have forced smallholder farmers to change planting date patterns. Similar studies by Singh et al. (2014) on cotton and peanuts in West Africa attest to this. While Loison et al (2017) argue that it is only partially true, as this decision should also take genetic variability into account.

Drought-resistant crops varieties

Unpredictable, prolonged dry spells and abnormally increased temperatures have contributed to negative impacts on crop production. However, smallholder farmers in the study areas have used moisture and stress-tolerant crop varieties as an adaptation strategy during droughts. For instance, in response to low precipitation, smallholder farmers have chosen to apply drought-tolerant crop varieties. Information obtained from focus group discussion and interviews revealed that maize, rice, sweet potatoes, millet, beans, and onions, were the main crops that alternative varieties had been selected.

Group discussions revealed that farmers have also altered their planting calendar to adjust to when it now rains. This suggests that numerous drivers influence farmer decisions about how to introduce new crop varieties in an area because of climatic conditions. In Krang Svat village, one elderly respondent stated, *"the growing season for the crop is determined by the climate. If there is no rainfall, then farmers do not plant"*. These findings are similar to studies by Komba & Muchapondwam (2012) and Mpandeli (2006) conducted in Limpopo River Basin in South Africa. Maponya & Mpandeli (2013) also revealed that smallholder farmers use drought-tolerant varieties as an adaptation strategy. This is also in alignment with the findings of Fisher *et al.* (2016), who highlighted how drought-tolerant varieties were used to promote climate-secure farming practices in Ananthapur District in India. In Samraong village, sweet potato and beans have been adopted as drought-resistant crops in response to extreme weather conditions.

Mixed cropping farming

Many farmers were found to employ mixed cropping methods as a traditional method of adapting to the changing climate conditions. Around 83% of farmers in the study cohort were found to use this practice to improve crop yields (Table 6). By this approach, selected varieties of crops are cultivated simultaneously on the same plot of land to reduce the depletion of soil moisture and nutrients. Smallholder farmers apply this practice this technique to guarantee a harvest when other crops fail because of climate shocks. A study by Mkonda et al. (2018) in Tanzania reported that most cultivated fields within the study area cultivated two or more crop types depending on the location of the farm and the preferences of the farmer. For instance, farmers in dryland areas of Nguru district in Nigeria intercropped maize with beans and groundnut with sesame. During a field survey, it was observed that most of the farms in Koas Krala District cultivated more crops per plot than those in Nguru. In Chhnal Moan mixed cropping was applied in conjunction with drought-resistant crops, such as beans and okra. These practices support empirical evidence that suggests that growing both trees and crops on the plot farmland has the benefit of decreasing evapotranspiration during heatwaves (Eze, 2017; Sze, 2018. Eze et al., 2018). This is useful for farmers in Dudiri, as the study area is located in a semi-arid ecological zone with high temperatures.

Conclusion

This study outlines how climate variability has influenced small-scale farmers to employ coping and adaptation strategies at the local scale. Focus

group discussions, questionnaires, and interviews were used to collect data. It was revealed that adaptation is a process of recognizing the impacts of climate change and adapting to the changed conditions. Due to their perceptions about the impacts of climate change, farm households were shown to have adopted on-farm activities to improve their resilience to climate change impacts. Small-scale farmers use strategies to adapt to climate impacts on crop yields by planting several crop varieties, including drought-resistant and short cycle crops, as well as intensifying production by using furrow irrigation. In line with the results of this study, adaption strategies require a detailed understanding of the determinant small-scale farmer decisions to have an impact. These strategies need to respond to both socio-economic and physical variables to influence the adaptive capacity of farming households. In this study, the determinant that affected farmer decisions were found to include: the educational level of the household head, the size of the landholding, access to information about climate change, off-farm activities, and changes in rainfall and temperature.

The success of climate change adaptation strategies is largely reliant on effective planning. Government departments and community actors play an important role in influencing the extent to which the vulnerability of farmers can be overcome in response to climate hazards. Strategic planning at the national level should be informed by the decisions at the farm-level, with clear accountability and supported by sufficient financial capital. It is important to identify strengths in the roles different stakeholders play in adaptive planning how activities may be coordinated. Concern about

vulnerability to drought and its adverse impacts on livelihoods have led to farmers in each study district adopting different coping strategies. However, this varies from household to household, dependent on various social, institutional and ecological factors.

Although the findings in this study relate primarily to coping strategies, they are also relevant to adapting to long-term climate change impacts as they provide insight into how farmers do and do not cope with changes to livelihoods and food security. Understanding how smallholder farmers have responded to climate variability in the past and how they can respond now, including the nature of institutional support that is available; provides a baseline for designing long-term adaptation strategies. As agricultural production remains the main source of livelihood for most rural communities, climate adaptation is imperative for protecting the livelihoods of the poor. This will require the involvement of multiple stakeholders, including policymakers, extension agents, NGOs, researchers, communities, and farmers. Effective policies are critical for creating an enabling environment for adaptation. Important policy areas include education, access to extension services, credit, pricing and market policies, the distribution of food commodities, and research and development.

Acknowledgements

Biographies

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Appendix

Table 3. Data collection methods

Activity	Selection	Koas Krala, Cambodia	Nguru, Nigeria	Topic and focus of activity
Semi-structured interviews and open-ended discussions	Households of poor, medium and high socioeconomic status	16 people in the 4 study villages.	20 people in the 4 study villages.	Explore farmers´ risk perceptions and their attitudes regarding coping with drought
Household questionnaires	Systematic random sampling. Every third household was selected for an interview.	70 households	116 households	1) socioeconomic profile of the respondent; 2) climate variability and extremes experienced in the last two decades and their impacts; 3) household's vulnerability in terms of food availability, livelihood, etc.; and 4) coping strategies.
Focus group discussions	Men only; women only, and mixed groups	Three in Koas Krala	Three in Nguru	Employed a combination of participatory techniques such as timeline analysis, stakeholder analysis, participatory vulnerability assessment, and community mapping of vulnerable areas
Key informant interviews	Local officials, representatives of agricultural services (extension, credit and research) at provincial and state agricultural offices, NGO personnel, leaders of farmer unions and associations	Mainly at the district headquarters and study villages	Mainly at the district headquarters and study villages	Contemporary information on local institutions and policies on climate change and drought
In-depth discussions	Individuals from households classified as high and low drought impact	Eight men and eight women in total (two men and two women each in the 4 study villages)	Eight men and eight women in total (two men and two women each in the 4 study villages)	Pattern of coping by households during drought

Enhancing Quality of Life through Sustainable Urban Transformation in Cambodia: Introduction to the Build4People Project

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សារគន្លឹះ

✓ សេចក្ដីសង្ខេបគោលនយោបាយជាលទ្ធផលស្រាវជ្រាវក្នុងដំណាក់កាលបឋម របស់គម្រោង ″ការសាងសង់សម្រាប់មនុស្សរស់នៅ ឬហៅកាត់ថា B4P″ (គម្រោងនេះមានច្រើនដំណាក់កាល) ដែលឧបត្ថម្ភដោយរដ្ឋាភិបាលអាល្លឺម៉ង់ ក្នុងកម្មវិធី ″ការអភិវឌ្ឍប្រកបដោយបរិភាពក្នុងតំបន់ទីក្រុង″។ ដំណាក់កាល

បន្ទាប់មានរយៈពេលប្អូនឆ្នាំ ដោយផ្តោតលើការស្រាវជ្រាវ និងអភិវឌ្ឍន៍ (ដំណាក់កាលអេនឌី ឬសរសេរកាត់ថា RD) ដោយយកដំណាក់កាលបឋម ជាមូលដ្ឋាន។ គម្រោងស្រាវជ្រាវនេះមានកិច្ចសហការពីអ្នកស្រាវជ្រាវនៃសាកល វិទ្យាល័យអាល្លឺម៉ង់ចំនួន៤ ក្រុមហ៊ុនអាល្លឺម៉ង់ចំនួន២ និងដៃគូស្រាវជ្រាវ អនុវត្ត និងផ្សព្វផ្សាយនៅកម្ពុជា។

✓ បុព្វហេតុនៃគម្រោង "B4P" គឺសន្ធុះរីកចម្រើននៃសេដ្ឋកិច្ចនៅភ្នំពេញ រួមផ្សុំនឹង ការសាយភាយនៃនគររូបនីយកម្ម និងវិស័យសំណង់។ ប៉ុន្តែ អាគារនិងប្អូរថ្មីៗ កម្រនឹងបានសាងសង់ឡើងប្រកបដោយចីរភាព ដែលបណ្តាលឲ្យមានផល ប៉ះពាល់ទាំងវិជ្ជមាន ទាំងអវិជ្ជមាន ទាំងដោយផ្ទាល់ និងដោយប្រយោលទៅលើ បរិស្ថាន។ អ្នកសម្រេចចិត្តធំនៅក្នុងវិស័យសំណង់ ក្រសួងពាក់ព័ន្ធនឹងសំណង់ រដ្ឋបាលសាលាក្រុង និងអ្នករស់នៅតាមអគារ មិនសូវបានចាប់អារម្មណ៍លើ បញ្ហាចីរភាពនេះប៉ុន្មានទេ។

✓ វត្ថុបំណងចម្បងរបស់គម្រោង B4P ដែលមានអ្នកជំនាញមកពីពហុវិស័យ ក្នុង ដំណាក់កាល RD គឺគាំទ្រ និងវិភាគករវិធីផ្លាស់ប្ដូរពីរបៀបអភិវឌ្ឍទីក្រុងដូច សព្វថ្ងៃ ទៅរបៀបអភិវឌ្ឍមួយទៀតប្រកបដោយចីរភាព និងភាពងាយស្រួលរស់នៅ កម្រិតខ្ពស់។ ការស្រាវជ្រាវនេះផ្តោតលើផ្នែកផែនការសាងសង់អគារនិងផ្ទះល្វែង ក្នុងប្អូរៃ។

✓ ដើម្បីសម្រេចវត្ថុបំណងក្នុងដំណាក់កាល RD យើងបានប្រើប្រាស់វិធីសាស្ត្រ ឧបករណ៍ស្រាវជ្រាវ និងនីតិវិធីគន្លឹះមួយចំនួន ដែលរួមមានសិក្ខាសាលារៀបចំ ផែនការរួមគ្នា វិធីគ្រប់គ្រងយុទ្ធសាស្ត្រពិសេស វិធីគ្រប់គ្រងអំឡុងពេលអន្តរកាល និងការអនុវត្តបទពិសោធតាមជំហាន។ វិធានទាំងនេះនឹងផ្តល់ចំណេះដឹងដល់ អ្នកពាក់ព័ន្ធនៅមូលដ្ឋានក្នុងការអនុវត្ត ក្នុងនិងការសម្រេចចិត្តដោយយកកស្តុតាង ជាមូលដ្ឋាន។

✓ ការវិភាគគុណភាពជីវិតនៅទីក្រុងដោយយកមនុស្សជាកត្តានាំមុខជាចំណុច គន្លាប់គ្រប់ទិដ្ឋភាពទាំងផ្នែកវិទ្យាសាស្ត្រ ទាំងក្របខណ្ឌទស្សនៈ ទាំងការវិភាគ ស៊ីជម្រៅ និងទាំងនិយាមសង្គម។ ក្នុងអំឡុងនៃការស្រាវជ្រាវ យើងនឹងរួមគ្នា

បង្កើតក្របខណ្ឌទស្សន៖ បង្កើតគម្រូផ្ទៃងៗ និងវិធីសាស្ត្រវាស់វែងគុណភាពជីវិតនៅទីក្រុងដោយផ្សារភ្ជាប់ជាមួយកត្តានយោបាយ និងកត្តាបរិភាពជានិច្ច។

Key Messages

✓ This policy brief introduces preliminary research results of the Build4People project, funded by the German government as part of the multi-phase focus programme "Sustainable Development of Urban Regions". Furthermore, the research agenda of the upcoming main four-year Research and Development phase (RD phase) will be introduced based on insights gained in previous shorter funding periods. The Build4People research consortium consists of representatives from four German universities and two German companies with their respective research, implementation and dissemination partners in the Kingdom of Cambodia.

✓ Build4People's rationale is based on Phnom Penh's dynamic economic growth, which is coupled with a local urbanisation and construction boom. However, new buildings and neighbourhoods are rarely constructed in a sustainable way with direct and indirect negative environmental impacts. Issues of sustainability are hardly addressed by decision-makers in the construction sector, related ministries, city administrations or building users.

✓ The overall aim of the multi- and trans-disciplinary Build4People project during the RD phase is to support and analyse the transformative shift in Phnom Penh's current business-as-usual urban development pathway towards a pathway with higher sustainability and liveability levels. The entry points for the research are the building and neighbourhood planning sectors.

✓ Methods, tools and key instruments to achieve the objectives of the RD phase are collaborative planning workshops, strategic niche management approaches, transition management approaches and subsequent experimental implementation. All of these measures will generate applied knowledge for local stakeholders and a basis for evidence-based decision-making.

✓ Urban quality of life as a people-driven approach serves as the integrating link for all of our scientific, conceptional, analytical

and normative dimensions. During our research, we will jointly conceptualize, measure and model urban quality of life and consider its political dimension and its often-ambiguous relationship to sustainability.

Keywords: Sustainable buildings, sustainable urban transformation, integrated urban people-centric development, urban quality of life, sustainable urban development pathways, pro-environmental behaviour and sustainable living, Royal Kingdom of Cambodia

Introduction: General problem description

The current COVID-19 pandemic not only highlights the requirements and necessities of services, functions and infrastructures that urban areas need to provide for their citizens. It also highlights *"the gravity of the current crisis makes the need for transformative urban change clearer than ever"* (WRI, 2020). UN General Secretary António Guterres recently introduced policy recommendations with regard to this challenge, arguing that the COVID-19 crisis is *"an opportunity to reflect and reset how we live, interact and rebuild our cities"* (UN 2020). In a policy brief, Guterres suggests that the capacities of local governments must be strengthened and the economic recovery must be realised as a green, resilient and inclusive one (UN, 2020). Furthermore, the crisis revealed that residents, unable to commute and travel during the lockdowns, have been thrown back on their neighbourhoods, community networks and direct personnel urban environment. Urban citizens are more aware than ever that a high quality of life within their neighbourhoods is very valuable for living, working and recreation.

As part of the global megatrend towards urbanisation, an increasing share of buildings is concentrated in urban areas. Decarbonising the buildings and construction sector responsible for about 38% of energy- and process-related emissions worldwide is critical for achieving the UN Sustainable Developments Goals and the Paris Agreement commitment (United Nations Environment Programme, 2020). In fact, sustainable buildings can arguably be identified as *"one of the most significant, cheapest and fastest approaches to reduce greenhouse gas emissions at the local scale"* (Preller et al., 2017: 217–218; OECD & IEA, 2013; UNEP & Global ABC, 2016).

This is particularly relevant for countries like the Kingdom of Cambodia, which are confronted with enormous building activities in their biggest cities like Phnom Penh, Sihanoukville and Siam Reap. With an annual contribution of 9-10% to GDP, the construction sector is one of Cambodia's key industries (Durdyev et al., 2016). The boom in this sector contributed to World Bank Group's reclassification of Cambodia from the status of a "low-income country" to the status of a "lower-middle-income country" in 2016 (McGrath & Kimsay, 2016). The International Finance Corporation (IFC) believes that 50% of the buildings with long-lasting impacts regarding sustainability that will be standing in Cambodia in 2050 have not been built yet (IFC, 2016). The IFC also notes that incorporating (energy and resource) efficiency into new designs is up to ten times more cost-efficient than retrofitting them (IFC 2016).

In addition, further urban expansion of the bigger cities is to be expected. For example, the Global Green Growth Institute (GGGI) anticipates a

doubling of the urban population in Cambodia by 2030 and warns of housing shortages and an under-supply of infrastructure in this context (GGGI, 2016). GGGI, in its Phnom Penh Sustainable City Plan 2018-2030, has also demanded guidance on *"constructing or retrofitting energy-efficient housing and buildings"* as a priority action in regard to the built-up environment (GGGI, 2019: 59).

To reduce carbon emissions from buildings and energy supply systems effectively and economically, an energy-efficient urban layout is of key importance (Bott et al., 2019). In the context of Cambodia, this means that adapted climate-responsive solutions have to be explored and implemented within the next years. Besides the level of buildings, the planning and implementation of sustainable neighbourhoods plays a key role: *"As socio-spatial units, neighbourhoods offer a suitable scale of intervention for integrated planning and packages of measures for sustainable urban redevelopment."* (Bott et al., 2019: 22).

Whereas some developments in Phnom Penh might be connected to enhanced liveability levels, i.e., increased use of individually owned cars, the latter have had negative consequences on sustainability levels, i.e., higher carbon emissions and air pollution. They also have potentially detrimental effects in other liveability dimensions such as walkability or air quality. Liveability has increased more for some parts of the urban population than for others. For example, a significant number of high-rise condominium towers, urban and suburban residential enclaves and gated communities have been developed over the last years targeting the urban upper and middle classes "new consumers". However, many of the negative

consequences for public infrastructure such as an increase in traffic jams and the environment are externalised from the general public (Paling, 2012; Fauveaud, 2015). Striking examples of these processes have been large-scale evictions and re-locations of lower-income communities as well as the filling of urban lakes. Urban lakes that often formed the basis of their livelihoods, provided ecosystem functions such as serving valuable retention spaces in case of heavy rainfall events have been transformed into luxury housing and other speculative real estate investments (Beckwith, 2020). These developments don't seem to have improved the quality of urban life for the urban majority, nor are they conducive to urban sustainability. The Economist Intelligence Unit (EIU) in 2015 rated the liveability of the city as fairly low – at least compared to its regional peers and by international standards. Its ranking placed Phnom Penh only 126th out of 140 cities globally (EIU, 2015).

At the same time, the development towards a modern consumer society in Cambodia has resulted in more resource-intensive lifestyles than when compared to the last four decades. This strongly affects the way buildings are designed, built and operated. This can be simply illustrated by monitoring the increase in electricity consumption. Within just the past 15 years, development in Cambodia has pushed electricity consumption per capita from about 70 kWh in 2005 to 530 kWh in 2018 (IEA Data Services, 2021a). While this energy consumption may seem low when compared regionally (PR China: 4,910 kWh, Vietnam: 2,380 kWh), it is expected to rapidly rise in the near future (IEA Data Services, 2021b). Already now, electricity consumption is very much focused on the country's primate city: Phnom Penh accounts for

about 85% of the national electricity consumption, but only for about 10% of the Cambodian population living in Phnom Penh (Pode et al., 2015). Therefore, the Build4People project is timed to coincide with the beginning of an expected development expansion and can additionally benefit from past research and trans-disciplinary project implementation experiences of Build4People team members in Vietnam or China. Applying lessons learned from those previous experiences can improve and strengthen the Build4People project's implications and recommendations for Cambodia's sustainability practices in the urban sector at its relatively early stage of development.

Preliminary research results

Preliminary research results of altogether six scientific work packages have been gathered during a six-month so-called Preparation phase (November 2017 until April 2018) and an 18-month so-called Definition phase (August 2019 until January 2021). Build4People's research has generally confirmed that the awareness of sustainability issues in Cambodia's building and construction sector is low, although gradually gaining support from stakeholders. Though the basic principles and necessities of sustainable buildings and sustainable urbanisation have been widely disseminated worldwide in recent years, including through major donor organisations like the Asian Development Bank (ADB) or the United Nations Development Programme (UNDP), local stakeholders and practitioners complained that they lacked knowledge about how to apply sustainability solutions within the existing technocratic and top-down planning approaches and the existing socio-institutional environment. In short, the most important issue was a lack

of actionable knowledge, e.g., how to overcome implementation gaps in the field of sustainable urban development. It became clear that effective implementation requires a detailed analysis (including of the socio-economic environment), development of adapted and localised measures (including the use of action research), long-term strategies, and more collaborative and strategic planning approaches.

At the same time, local stakeholders in Phnom Penh showed general interest in the holistic concept of urban quality of life that was communicated as the overall normative aim of the Build4People project. Initial discussions on how to reconcile individual life satisfaction with objective standards of sustainability also revealed that more research is needed in this field.

An important insight from the perspective of environmental psychology with regard to the environmental awareness of people in Phnom Penh was the difference between local and global environmental issues. The awareness and understanding of environmental problems seem to be directed towards local problems, such as air pollution and the lack of waste management, rather than global environmental problems such as climate change. Local organizations and institutions have already taken some measures to address those environmental problems, e.g., by promoting the avoidance of plastic, saving of drinking water, enhanced waste management, etc. Posters and other awareness-raising materials on these topics are observable in public spaces, official institutions or restaurants. The problem awareness and understanding of global environmental problems such as "climate change" turned out to be less salient.

Citizen's "climate awareness" can be defined at two levels: In a local context, and in terms of a global problem understanding of climate change (Li, 2015). There seems to be a need to strengthen awareness of the global consequences of individual and local behaviour and the importance of sustainable lifestyles in the long term. From the sustainable building perspective, it was perceived that common practices include reliance on (often imported) construction methods and standards, building designs and materials that are often inappropriate to local climates and conditions (see also Bodach, 2019). Despite the high electricity prices, passive energy-saving potentials applied to building techniques are rarely taken into account. All this happens notwithstanding the rich heritage of building designs from the modernist era, known as New Khmer Architecture, and from the colonial era that was erected following bioclimatic design principles (Kolnberger, 2014; Waibel, 2017; Bodach & Waibel, 2017).

Furthermore, construction professionals displayed a lack of knowledge in adopting sustainable design principles, construction methods and in advancing low-energy building system technologies. Often, no consideration is given to life-cycle issues or bridging the divide between the economic life-cycle phases of the buildings by making sustainability transparent, e.g., by employing evidence-based and predictive design techniques and instruments such as building certificates. The research showed that necessary sustainable technologies for the change from traditional bioclimatic design to technically equipped modern buildings are not available in the Cambodian market and must be developed strategically, along with their necessary market context (Schwede, 2020). Finally, various local experts confirmed that recently

erected buildings and neighbourhoods primarily target the high-end of the market and are only partially in line with the urban population's actual demand.

Major insights from the perspective of sustainable neighbourhood development were gained through the organisation of the Build4People Ecocity Transition Lab at Phnom Penh City Hall. This was an interactive workshop and charette stretching over one week, which proved very valuable for understanding local issues, capacity-building, and the implementation of transdisciplinary collaboration in complex sustainable urban developments. During the Ecocity Transition Lab, it became clear that there is a strong demand for sustainable urban renewal and neighbourhood development approaches. A particular outcome was that while there is a framework of planning systems and multiple planning policies, there is hardly any synergy between the Socio-Economic Development Plan and the Spatial Plan, which are the major planning systems. Furthermore, a lack of capacity (funding and technical skillsets) has been identified as a bottleneck for developing qualified urban, spatial and land use plans, especially at the Khan and Sangkat levels (see also Makathy, 2016; World Bank Group, 2018). As a lesson learnt, the successful approach of the Ecocity Transition Lab will be extended and deepened in the upcoming project phase, along with creating a toolbox for sustainable neighbourhood development including strategies, guidelines and criteria as well as implementation strategies.

Based on the perspective of *"urban green"* as ecological infrastructure within cities, our research established that Phnom Penh has a growing need for the development of urban green space and public spaces. The city center

is mainly characterized by built-up and sealed-off areas. Apart from some existing urban historic parks and streets with old alley trees that provide shade in the hot periods, residents of Phnom Penh use green spaces for recreation, leisure, sports and cultural events.

However, due to intensified urban sprawl and densification of urban land use, the spatial share of urban green space is rapidly decreasing in Phnom Penh since 2000, leading to increased flooding problems during the rainy season. One of the key findings of the 1st Build4People Ecocity Transition Lab in March 2020 was that officials and citizens alike consider urban green space to be an important feature for urban planning and sustainable development in Phnom Penh.

With regard to greater awareness-raising for the maintenance and promotion of more urban green space, we are fostering the idea of an Urban Green Infrastructure approach. This analytical framework allows for an analysis of urban green space in terms of its multi-functionality considering physical and functional connectivity and relates this to the capacity of ecosystems to provide multiple valuable ecosystem goods and services (EEA, 2017).

In analysing Phnom Penh's urban climate, the mesoclimatic conditions of the surrounding region must be considered. Therefore, a regional climate analysis was carried out to understand the ventilation effects during the different seasons. Here, two seasons are especially important, as they bring wind from two different directions that influence the urban climate. The urban climate analysis provided more quantitative results on urban heat islands and helped to formulate a methodology for deriving an urban climatic

map. The research showed a considerable temperature variation rate between urban and suburban areas ranging from 4 to 9 degrees Celsius. As this result is highly dependent on local city structures, more data on urban climate are needed to develop a valid urban climate model of Phnom Penh in the future. From land use data, building and vegetation information, the input layers for an urban climatic map were formed. These different datasets are needed to calculate an urban climate map (Ren et al., 2011) with a GIS-based method.

During a neighbourhood design project, the initial results were used to recommend climatically orientated urban structures to provide better ventilation for buildings and open spaces to reduce heat stress. Finally, a thermal comfort index was applied in the research on urban quality of life. With this classification, which encompassed indoor as well as outdoor conditions, various aspects of well-being were evaluated.

From the perspective of sustainable urban transformation, major problems may be related to institutional fragmentation and ambiguity. While governmental institutions do play a central role in urbanization processes, informal power structures and the entanglement of the private interests of political elites render the government's de-facto role much more ambiguous (Paling, 2012). Administrative responsibilities for sustainable urban development are scattered among many different national-level ministries and Phnom Penh City Administration (PPCA). PPCA itself has very limited financial and human resources and is generally considered to be in a relatively weak position with regard to land ownership and legal institutions between the central state and powerful private developers. Furthermore,

project implementation usually requires some form of *"buy-in from the local elite"*, i.e., a project-based and negotiated relationship between private-sector developers and state actors (Nam, 2017: 626). Local stakeholders have indicated in qualitative interviews that experimental pilot or demonstration projects, governmental incentive schemes as well as cooperative and multi-stakeholder platforms might be supportive or in favor of a sustainable urban transformation in Phnom Penh's building sector, whereas assumed cost increases, deficiencies of local capacity and a lack of market readiness might stand in its way.

Briefly, the preliminary problem analysis of the different work packages of the Build4People project showed that only systemic trans-disciplinary, cross-cutting and people-led enabling approaches can promote sustainability and to increase urban quality of life in Phnom Penh.

Objectives of the research and development phase

Based on the insights and experience of the previous preparatory phases, the overall aim of the Build4People project's upcoming four-year Research and Development phase (RD phase) is therefore to support and analyse a transformative shift in Phnom Penh's current business-as-usual urban development pathway towards a pathway with higher sustainability and liveability levels. For this purpose, the building sector will be used as the entrance point of the research.

Urban transition scholars have highlighted that such a sustainable urban transformation is not only a technological challenge but also a social, cultural, economic and political one (Rohracher, 2001; Rink et al., 2018). To contribute to an understanding of the challenges and to simultaneously

address these, the Build4People team will combine societal and scientific problem-based analytical research with transdisciplinary action research approaches. These aim to (i) understand and support possible transition pathways, barriers and drivers, and to (ii) align support of transformational change in the behavioural, environmental, technical and policy dimensions.

In general, the project's activities will support the gradual shift from a top-down planning culture, which so far has been rather technocratic and based almost exclusively on issuing static plans in a top-down manner, to a planning culture in which urban planning is more integrated, people-led and understood as a process and dialogue involving a broad spectrum of actors from government, civil society and the private sector in the development and implementation of strategies.

Figure 1 illustrates the ideal-typical impacts of the Build4People project. It shows the development path of Phnom Penh over time with stagnant or even decreasing liveability and sustainability levels in the recent past. In the figure, the Build4People interventions and action research (explained in more detail in the following) successfully support a sustainable urban transformation towards a pathway with higher sustainability and liveability levels. The project itself is visualised as an iterative set of interventions (helix) that are implemented in a transdisciplinary manner by the different work packages (WPs), distinguished by specific WP colours, under the guidance of WP7 (purple container).

Being fully aware that a transition is subject to complex and systemic processes, and that a complete and project-induced transition is, therefore,

unrealistic, the Build4People team considers the facilitation of intermediate transition pathways to be more feasible within the funded timeframe.

Figure 1. The overall aim of the Build4People Project (ideal scenario)
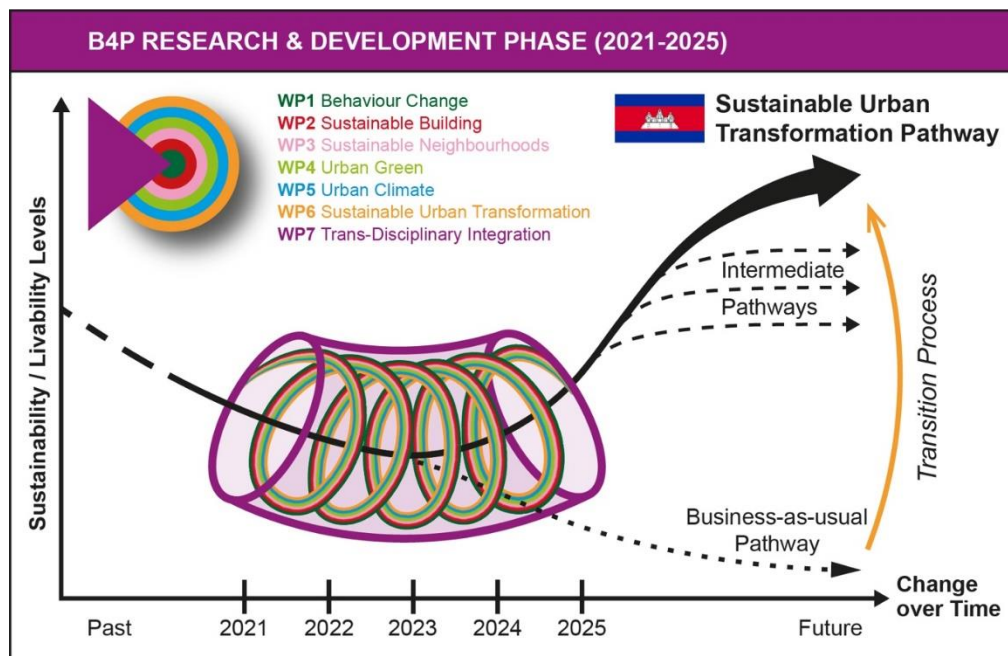
Source: Own design

Distinguishing our project from other predominantly poverty-led approaches implemented by state donors or non-governmental organisations in the Kingdom of Cambodia, additional focus will be put on the so-called *"new consumers"*, a key group in terms of global sustainability (Myers & Kent, 2003; Waibel, 2009). Despite the ongoing coronavirus crisis, a significant improvement in living standards can be anticipated with the expected boost of urbanisation in Phnom Penh. The predicted massive expansion of the urban middle-class population is expected to create an increasing demand for construction, prompting a sharply rising ecological

footprint due. The urban middle-class population will have specific requests in terms of urban quality of life, which may conflict with overall sustainability goals. The environmental psychologists of the project team will therefore scrutinize urban middle-class values, norms and behaviour to better tailor their intervention measures for effectiveness.

The common link of the Build4People project's scientific-conceptional, analytical and normative dimension is the urban quality of life (UQoL), which is considered to be the general foundation for our people-driven approach. Our team considers the notion of UQoL to be a multiple-dimensional concept that brings together "physical, psychological, social and ecological aspects and takes into account both subjectively perceived well-being and objective conditions" (WBGU, 2016: 86). Consequently, we will jointly conceptualize, measure, and model UQoL and also critically consider its political dimension and ambiguous relationship to sustainability. We will approach UQoL in two ways: based on an analytic research approach that enquires about the relative impact of different objective and subjective factors on urban quality of life, and a more normative approach that understands sustainable transformation as an essential prerequisite for UQoL. Finally, a multi-dimensional UQoL is also a linking factor when considering each level: the individual; the household, the building; the neighbourhood; the city.

Research design and methodology

The research design of the Build4People project consists of three overlapping spheres based on transdisciplinary research approaches in sustainability science (Lang et al., 2012; Noboa, 2019) (see Figure 2): (1) societal and scientific problem-based research; (2) transdisciplinary action

research, and (3) reflection, refinement & re-integration of created knowledge. In the first year, all work packages will approach the societal and scientific problems against the backdrop of the existing physical, socio-economic, cultural and political context. Within this sphere, the overall focus is on empirical data collection and data analysis, mostly done separately by each work package in cooperation with their local research partners (see Figure 2).

Figure 2. The general research design of the Build4People Project
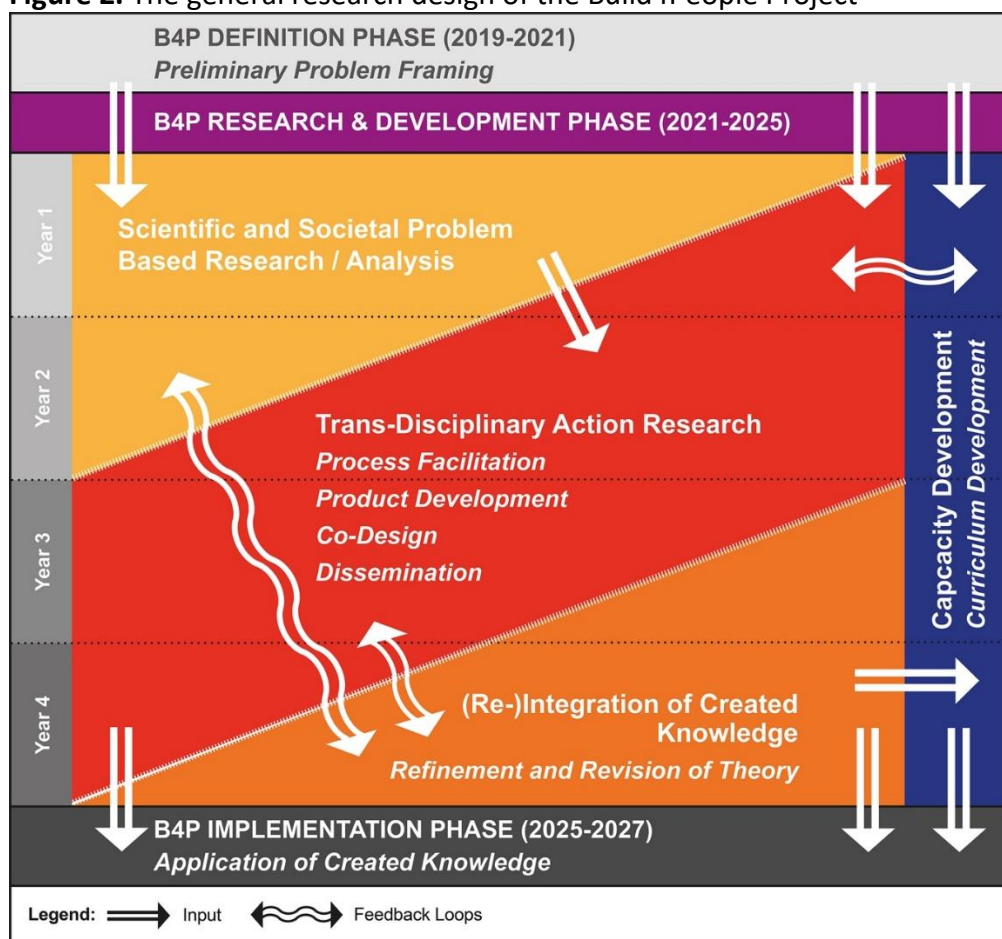
Source: Own design based on Lang et al., (2012: p. 28)

The most significant joint empirical research activity during this sphere is a large-scale joint household survey that aims to assess the status quo of UQoL by combining objective and subjective factors as a basis for intervention measures. A stratified representative sample is required for the evaluation of different factors that are expected to have a significant impact on their quality of life. The variety of factors is determined by results from previous research.

The research focus in years 2 and 3 will then shift to transdisciplinary action research in continuous exchange and cooperation with local stakeholders. In this context, the Build4People team defines action research as a reflective process of progressive problem solving and learning system that integrates research, action, and analysis (Riel & Lepori, 2014). This is to ensure that the project will bring together, apply and extend the initial research findings with the overall aim of generating actionable knowledge for local stakeholders and a basis for evidence-based decision-making. At the same time, this offers the opportunity to implement people-led perspectives. Here, learning systems such as the *Build4People Ecocity Transition Lab*, the *Build4People Sustainable Building Arena* and the *Build4People Sustainable Building Incubator* (see Figure 3) are facilitated, and the local stakeholders are actively engaged in a transdisciplinary knowledge co-production process with scientific inputs from all WPs.

From the perspective of sustainable urban transformation, the facilitation and analysis of those action research processes can provide valuable scientific insights into how socio-technical and socio-institutional

change can be influenced with the overall aim of supporting an urban sustainability transition in Phnom Penh.

Finally, tangible knowledge products as outcomes of Build4People transdisciplinary processes will be co-designed and developed step by step within the Build4People team. One prominent product is the *Build4People Toolbox for Sustainable Neighbourhood Development* (see Figure 3), which will include a catalogue of strategies, guidelines and criteria. These will be developed in the action research process and derived from the integrative masterplan framework for the case study site in Phnom Penh, as well as through adaptation of Southeast Asian and European approaches. In particular, the advanced assessment system for sustainable urban districts developed by the German Sustainable Building Council (DGNB) will be an important starting point. The Build4People toolbox will be presented in an easy-to-access and interactive web platform addressing different target groups such as city administrations, developers and consultants as well as universities. A special focus will be on the visualisation of the interrelations between the involved sectors for achieving comprehensive planning results and synergetic effects, which often make sustainable design economically feasible (Messerschmidt & von Zadow, 2019). Another related product that targets a wider audience is the *Build4People Handbook for Green Housing and Sustainable Living* (see Figure 3). This richly illustrated publication will be developed in a co-design process involving local stakeholders and designed to present, in an easy-to-understand language (thus being accessible to non-experts), information about technical, constructive corporate and behavioral solutions for climate-adapted green residential buildings. It will be published

as a soft copy and also via a web platform including interactive learning tools. In general, we do not regard the finalisation of products such as the handbook as the end of our research effort, but as a starting point for intensive dissemination and intervention campaigns through multi-stakeholder coalitions. This is to ensure application and mainstreaming with maximum outreach.

Finally, the Build4People toolbox and the Build4People Handbook are also regarded as key transdisciplinary instruments to integrate expertise and empirical research results from all work packages of the Build4People project and to foster engagement of partners from various institutions in Germany and, more importantly, in the Kingdom of Cambodia.

Furthermore, we aim for less tangible outcomes such as alternative discourses and narratives, new stakeholder coalitions, socio-institutional spin-offs and increased pro-environmental behaviour among the urban population. Empowered actors or change-makers /frontrunners, various participatory procedures, e.g. focus groups, multi-stakeholder workshops and a world café (Brown & Isaacs, 2005) will enrich the analyses of the Urban Quality of Life (UQoL) dataset, allowing a deeper, context-sensitive and joint concept of UQoL together with all its influencing factors. This will allow for the development of an empirical data-based and theory-driven framework for awareness campaigning to foster ecological awareness, pro-environmental social norms and sustainable lifestyles in Phnom Penh.

During year 4, the main focus will shift again to reflective research activities. Here, the findings from the transdisciplinary action research phase are connected to the theory-based research of year 1 in an iterative way

through feedback loops (see Figure 2). It will lead to the (re-) integration and refinement of created knowledge and finally to the revision and extension of theory and will also serve to re-adjust the processes and products that will be applied during the subsequent Implementation phase. An initial theory-driven and data-based draft of a UQoL-Model will be refined with respect to the outcomes of the transdisciplinary action research and with respect to the ongoing integration of more and more objective and subjective data. Based on this, the UQoL model will thereby identify promising measures to foster urban quality of life in Cambodia to be applied during the subsequent Implementation phase.

All in all, it can be safely assumed that due to the Build4People project's inter-/ trans-disciplinary approaches, new fields of scientific knowledge will be developed, with significant effects on disciplinary as well as interdisciplinary publication strategies.

Role of capacity development

Throughout the RD phase, cross-cutting input will be given to capacity mobilisation (see Figures 2 & 3). Already previously, local actors have shown both a need for and an interest in this field. In general, capacity building takes place intrinsically through regular communication and joint activities together with the research, implementation and dissemination partners. As mentioned above, the Build4People processes such as the Ecocity Transition Lab, the Sustainable Building Arena or the Sustainable Building Incubator are intended to generate actionable knowledge for local stakeholders.

In particular, there have been requests to support the development of new master courses or to provide input to existing master courses at our

research partner institutions. We have decided to focus on the development of a new multi-disciplinary Master course on *"Sustainable Urban Transformation Planning"* (working title) at the School of Architecture and Urban Planning at Paññāsāstra University. In contrast to other local courses in this field, which are usually very much focused on questions of design, the idea is to incorporate the Build4People project's holistic and people-orientated approach into the curriculum. The new course will not be a mere imitation of a curriculum or textbooks from universities of the Global North but will feed into the refined research findings of the Build4People team. This is expected to provide locally actionable knowledge, tools and feasible solutions that are conducive to more sustainable urban development pathways in Cambodia.

The Build4People team will complement these activities by critically reviewing existing course units and co-designing new course units in the context of the existing Master Course in Global Change (MICC) and a Master Course currently under development in the field of Geography at the Royal University of Phnom Penh. Also, at the Royal University of Agriculture, the topic of *"urban green"* will be integrated into the curricula at the faculty of Land Management and Land Administration. Further aims during the RD phase include efforts to organise joint summer schools, online work design studios or similar activities and to intensify the international exchange of faculty members. The joint curriculum development is regarded as another key transdisciplinary instrument to integrate expertise and empirical research results from all Work Packages of the Build4People Project.

Finally, the Build4People team strongly believes that contributing input to formats such as master courses will secure a lasting impact – even after the Build4People project funding ceases. The following figure 3 summarises the most important envisaged outcomes of the Build4People project along with the three research spheres.

Figure 3. Outcomes of the Build4People Project
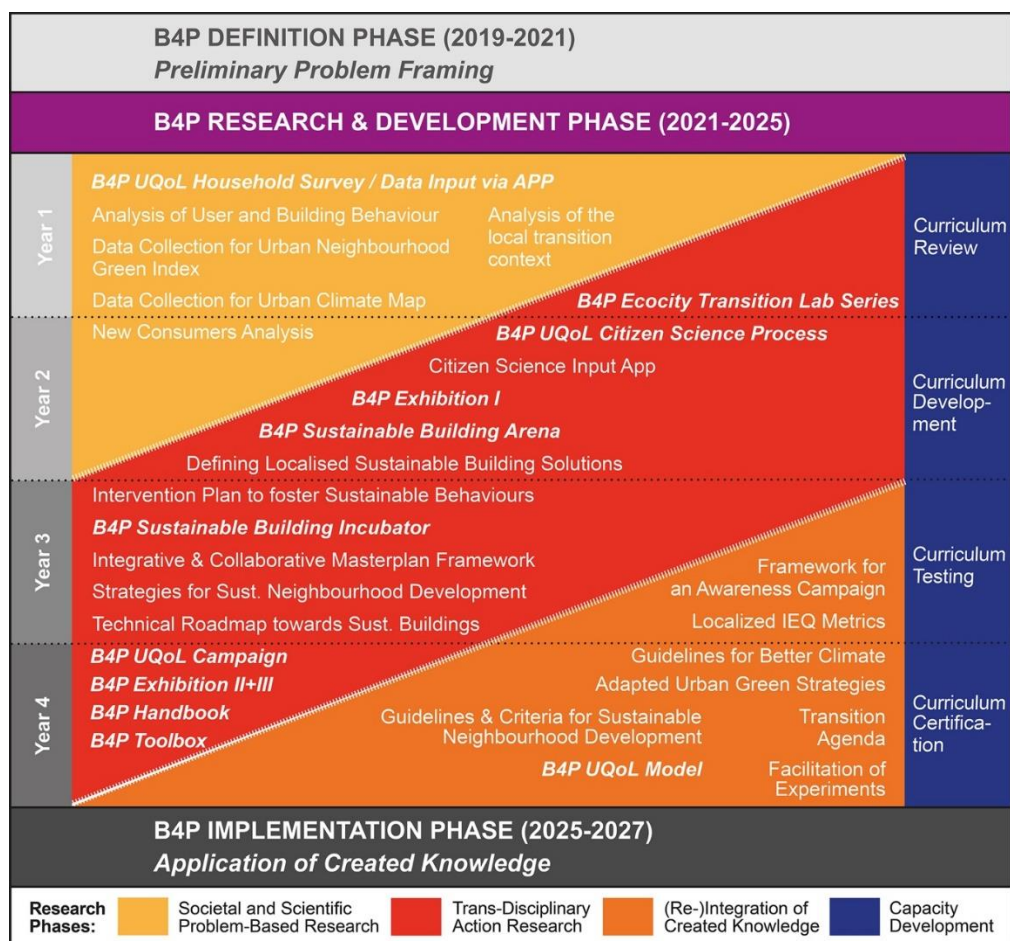
Source: Own design

Achieving successful cooperation within the Build4People project

With so many disciplines involved, transdisciplinary integration can only be achieved by implementing a research design that brings together all work packages closely together in empirical or societal data collection, in transformation processes such as the Build4People Ecocity Transition Lab, through joint capacity-building activities and the joint development of dissemination products.

Experience shows that transdisciplinary integration requires a great deal of time-consuming communication within the research team, but also between academia, policy-makers and the general public. Obviously, it also requires mutual respect on the part of the members from different disciplines. During the RD phase, all this will be facilitated through regular online meetings, workshops and rounds of monitoring, self-reflection, evaluation and learning. The key responsibility for managing the essential transdisciplinary integration will lie in the hands of the consortium lead at Hamburg University. Table 1a in Appendix 1 provides an overview of the Build4People project's cooperation structures.

Conclusion and outlook

The Build4People project is an ambitious implementation-oriented research project consisting of multiple disciplines and involving stakeholders from the spheres of state, economy and civil society (see Figure 1a, Appendix 1). In the context of the upcoming RD phase, sustainable urban transformation will be encountered by a systemic and cross-cutting approach. Build4People's innovative outcomes (see Figure 3) are based on an intricate three-phase research design including an analytical phase, action

research with stakeholders and a final phase of review and refinement of theory (see Figure 2). This is to ensure high-value scientific output as well as real implementation.

In this approach, comprehensive transdisciplinary research and added value can best be achieved through the design of joint activities and products (see Figure 1). The transdisciplinary research process will be connected to (a) national-level policymaking processes through Build4People project's membership in the inter-ministerial sector Technical Working Groups on Green Buildings and Sustainable Cities, (b) transnational initiatives through a regional technical roadmap as a localized part of UNEP's global road-mapping activities, and (c) the local start-up scene through a sustainable building incubator.

The Build4People project results will be further disseminated through tangible knowledge products such as a toolbox, a handbook or several exhibitions reaching out to different target groups via locally established multipliers.

All of these factors combined are intended to support the transformative shift of Phnom Penh's urban development pathway towards higher sustainability and liveability levels. A lasting impact beyond the Build4People project funding period itself is also be achieved through capacity-building activities with a focus on curriculum development support among Build4People's research partners at local universities. This is also regarded as an opportunity to feed in the refined research findings and serves as another transdisciplinary instrument to compile and connect results from all work packages.

To ensure application and mainstreaming with maximum outreach, we generally do not regard the finalisation of research outcomes as the end of our efforts, but as a starting point for intensive dissemination and intervention campaigns through multi-stakeholder coalitions. In this context, the long-term funding perspective of four years, even with a subsequent two-year implementation phase, is another strategic advantage of the Build4People project. In general, it can be concluded that research projects such as Build4People can only work out solutions for sustainable urban development together with urban society. By actively communicating and cooperating with multiple stakeholders, their concerns and competencies can be integrated into the research process. At the same time, the understanding of the areas of concern on the part of society and the motivation to implement sustainability measures can be increased. Based on a common understanding of the problem, innovative approaches can not only be developed but also tested by using scientifically monitored, real urban district developments. Among others, this is applied by means of the Build4People Ecocity Transition Lab as a transformation platform and as a tool of integrated urban development. Ultimately, however, the success of the project will require a great deal of inward and outward-orientated communication in combination with mutual recognition of the competencies of each scientific discipline involved, and of the local cultural specificities in particular.

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Methodology, all authors;

Writing—review and editing, Waibel, M., Mund, J.-P.;

Visualization, Waibel, M. (all figures), Jayaweera, R. (figure 1 & 2);

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Biography

The corresponding author Michael Waibel has been working as a senior researcher, lecturer and project leader at the Department of Human Geography of the University of Hamburg, since 2007. From 1996-2007 he was a research associate at the Department of Human Geography of the University of Göttingen. He holds a PhD in Human Geography and an M.Sc. in economic geography, geography and national economy with key competencies in urbanism, sustainability sciences, housing, urban governance, urban lifestyles and green growth approaches. He has about 25 years of international experience in academic work, consultancy work and capacity development in Southeast Asia as well as in East Asia. In 2001 he published his Ph.D.-thesis about the urban development of Hanoi / Vietnam. He has benefited from well over 100 study trips to the Asian region.

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Appendix

Figure 1a. A comprehensive overview of Build4People consortium

German Partners	Magdeburg University (OvGU)	Stuttgart University (USTG)	Eble Messerschmidt Partner (EMP) *(SME)*	Eberswalde University for Sustainable Development (HNEE)	Institute for Climate and Energy Concepts (INKEK) *(SME)*	Hamburg University (UHH)
Cambodian Partners	Royal University of Phnom Penh (RUPP)	Institute of Technology of Cambodia (ITC)	Paññāsāstra University of Cambodia (PuC)	Royal University of Agriculture (RUA)	Royal University of Phnom Penh (RUPP)	Royal University of Phnom Penh (RUPP)
Work Package (WP)	WP#1: Behaviour Change	WP#2: Sustainable Building	WP#3: Sustainable Neighbourhoods	WP#4: Urban Green	WP#5: Urban Climate	WP#6: Sustainable Urban Transformation
Focus	environmental psychology; conceptualization / modelling of UQoL; user behaviour intervention strategies and awareness campaigning; participatory and inclusive approaches; gender dimension of sustainable living and UQoL	sustainable, energy efficient and climate adapted building; comfort assessment; IEQ measurement; design & simulation; parameter studies (LCA, LCC); development of assessment standards; building physics	strategies, guidelines and criteria for sustainable neighbourhood development; assessment and certification standards (in cooperation with DGNB); conceptualization of B4P toolbox; main facilitation of ECTL; exhibition curation and design	urban and neighbourhood level; geo-spatial analysis of urban green infrastructure; calculation of green urban neighbourhood index; UQoL Citizen Science Input APP; statistical data modelling; project data management within Nextcloud	urban and neighbourhood level; urban heat island; human thermal comfort; ventilation streams; resilience against climate change; urban climate modelling; urban-rural climate linkages; regional climate map	transition studies and urban governance; socio-techno-political system and urban development regime analysis; socio-institutional and socio-political context; transition management; strategic niche management; transition pathways; facilitation of experiments
Responsible Persons	Dr. Anke Blöbaum / Prof. Dr. Ellen Matthies /	Dr. Dirk Schwede	Rolf Messerschmidt	Prof. Dr. Jan-Peter Mund	Prof. Dr. Lutz Katzschner / Sebastian Kupski	Dr. Michael Waibel
Consortium Leader (UHH)	WP#7: Coordination, Communication & Dissemination *Overall project management, trans-disciplinary integration within Build4People Project, conference organisation, logistics support to Build4People processes, dissemination and event organisation, advocacy, impact management, PR work, social media strategy, coordination of joint master course development as key part of Build4People capacity mobilisation activities, liaison with the implementation and dissemination partners as well as to the corporate sector, industrial fair participation*					
Responsible Persons	Dr. Michael Waibel Dr. Susanne Bodach (local project assistance)					
Project Management Partner	➤ Cambodian Institute of Urban Studies (CIUS)					
Key Implementation Partner	➤ Phnom Penh Capital Administration (PPCA)					
Capacity Mobilisation Partners (Curriculum Development)	➤ Paññāsāstra University of Cambodia (PUC) ➤ Royal University of Phnom Penh (RUPP) ➤ Royal University of Agriculture (RUA)					
Corporate Cambodian Research Partners	➤ Urban Living Solutions, Phnom Penh ➤ Green Infrastructure Solutions, Phnom Penh					
Dissemination Partners	➤ European Chamber of Commerce of Cambodia (EuroCham), Phnom Penh ➤ Centre for Khmer Studies (CKS)		➤ META House, Phnom Penh ➤ Industrial Fair Cambodia Architect & Décor, Phnom Penh			
Scientific Advisory Board	• Dr. Stephan Anders, DGNB • Dr. Eduardo Noboa, WorldFuture Council • Mélanie Mossard, Impact Hub PP • Bradley Abbott, GGGI, Phnom Penh		• Andéol Cadin, Chairperson of Green Business Committee of European Chamber of Commerce Cambodia • Michel Cassagnes, Chairperson of Real Estate & Construction Committee of European Chamber of Commerce Cambodia			

Source: Own design

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Japanese people who love to live in Cambodia tend to admire Khmer culture and people. However, in their body and mind, Japanese people strongly adhere to their own culture from birth. A book has been written demonstrating what this culture is. Its name is *"The Book of Tea"*. Author, Kakuzo Okakura originally wrote *"The Book of Tea"* to a Western audience in the English language in the early 20th century. Okakura, who was Japanese first published his book in 1906 in New York. It was also published in Sweden, Germany, France and Spain. In 1929, the book was translated to Japanese and has since been republished 118 times. Tea is the title of the book, but it is not about only tea. In the book, Okakura explains the term *"Teaism"*, which refers to the influence of tea in many aspects of Japanese culture, ways of thinking, and life. While it was first published long ago, the ideas of the book have not dated. Many Japanese read and understand the analysis of the author as it relates to situations in Japan in 2020.

The book became accessible to an international audience as Okakura was born into the family of a foreign trade merchant and studied English from a young age. He specialized in the visual arts and focused especially on Japanese art. The more he studied foreign culture, the more he grasped the importance of the culture in his own country. The content of the book highlights Japan's unique aesthetic sense and world-view, condensed into a cup of tea. This dense book approaches the essence of what good sense is and what beautiful means for Japanese people. It comprises seven chapters. In the first chapter, Okakura introduces various aspects of Japanese culture, starting with the tea ceremony. From Chapter 2 to Chapter 6, Okakura explains all things that link tea to Japanese culture, such as Taoism, the tea room, and flowers. In the final chapter, he introduces the idea of true beauty for Japanese people through the stories of tea-masters and their lives.

Chapter 1 gives a taste of all essences of this book. Okakura argued that the substance of various cultures in the world is condensed in tea. *"Tea began as a medicine and grew into a beverage"* in China. In the 8th century, tea was created as a kind of art and in the 15th century, it came to Japan. There it was elevated to the religion of worship and beauty called the tea ceremony, which became a respectable ritual in Japanese daily life.

The essence of the tea ceremony is the worship of imperfection and the acceptance of the fact that things are not perfect. The ceremony is a gentle attempt to find something possible, even in the midst of a life destined for the impossible. The ceremony is more than just a ceremony. First, it is a kind of philosophy; however, *"the Philosophy of Tea is not mere aestheticism in the ordinary acceptance of the term".* Rather, it connects us with a theory or

a religion that informs us about various perspectives on humanity and nature. Second, the tea ceremony connects us to *"hygiene, for it enforces cleanliness"*. Third, the tea ceremony connects us to *"economics, for it shows comfort in simplicity rather than in the complex and costly"*. Moreover, the tea ceremony connects us with a *"moral geometry"* of mind as it provides meaning, which enables the development of a sense of balance with the universe. Okakura explained the same concepts in another book called *"The Ideals of the East"* (Okakura, 1903). Okakura believed that while everything had various aspects, tea brought them together; which is the definition of Teaism (Okubo, 2014).

Japan has a unique history - the country was closed to the world for more than 200 years (1639 – 1854) and became isolated by this closure. However, thankfully, this provided the country with sufficient time to review its culture and develop the tea ceremony. The tea ceremony has influenced Japanese culture both mentally and physically. It has taught Japanese people about things such as pureness and harmony, a depth of esteem for one another, and the awe of social order. The styles of architecture, daily customs, clothes, cooking, pottery, lacquer craft, drawing and literature were all influenced by the tea ceremony.

Chapter 2 explains the history of tea, as well as the School of Tea. Tea was born in China as medicine. In the 4th century, it became a drink, and in the middle of the 8th century, tea became respected as a ceremony for executives. Unfortunately, the tea ceremony fell into desuetude in China between the 13th to 17th centuries because of the domination of different races, such as the Mongolians. A Zen monk introduced tea to Japan in the

8th century, which is how the story of the tea ceremony developed. In the 15th century *"the tea ceremony became fully constituted into an independent and secular performance. Since that time, Teaism has been fully established in Japan* ″ . The ceremony was not only for executives but also for ordinary citizens. For Japanese people, the tea ceremony was a religion, teaching people how to live. That is why Okakura called it Teaism.

The tea ceremony provided the value of modesty to Japanese people. From a global perspective, the Japanese were thought of as humble and polite, which was influenced by the ideas within the tea ceremony. For example, within the tea ceremony, vivid colours could not be harmonized within the tea room, sounds that disturbed the rhythm of the ceremony, and behaviours that destroyed the atmosphere and words, and broke with unity, were all prohibited because they were no match with nature. Harmony, rhythm, atmosphere, and unity are important elements in Japanese lives.

Chapter 3 explains Taoism and Zennism, as tea is deeply related to Taoism. The author wrote *"we have already remarked that the tea-ceremony was a development of the Zen ritual. The name of Laotse, the founder of Taoism, is also intimately associated with the history of Tea."* Taoism emphasizes the importance of empty, meaning that emptiness could accept everything. For example, the importance of a room is not the wall or ceiling, but the empty spaces. The same is true for the human body when it exercises. The body should be empty. *"This empty theory has greatly influenced all our theories of action, even to those of fencing and wrestling".* For instance, this is reflected in the traditional Japanese sports of Kendo and Judo. Kendo is a kind of fencing using bamboo staves. Judo is a kind of

wrestling method of defending oneself or fighting without the use of weapons. The theory also influenced the visual arts. The area that an empty space accepted invited people who could see the art. People became attracted to this theory and felt a sense of affinity with the art.

Zennism following Taoism. In Zennism, *"the most respected and advanced monks were given the more irksome and menial tasks".* This was emphasized as a kind of training. *"Such services formed a part of the Zen discipline and every last action must be done absolutely perfectly"* The idea of the tea ceremony derived from this thinking within Zennism and found greatness in the small details of the lives of Japanese people.

Chapter 4 explains the tea-room, where the tea ceremony is conducted. *"To European architects brought up on the traditions of stone and brick construction, our Japanese method of building with wood and bamboo seems to be scarcely worthy to be ranked as architecture"*, Japanese architecture style was influenced by the tea-room. By the empty theory, the tea-room eliminated any extra decoration and valued empty space. The imagination could fulfil the work of finishing by leaving some elements unfinished, symbolizing the spirit of respecting imperfection. This concept of the tea ceremony had had a profound influence on Japanese architecture from the 16th century. Ordinarily, the interior design of current and typical Japanese houses would have felt tasteless by Western people.

Another interesting aspect of the tea-room was that the entrance of the room was small, and the height was under one meter, so everybody had to bend down to enter the room. The style was for awareness of humility. Even in the daytime, the tea-room was dim, and guests carefully wore clothes in

dark colours. Cleanliness was required. These thoughts came from the idea of beauty in nature. The style of the tea-room was based on ancient Japanese architectural ideas. Eternity was the idea, not a substance but in the spirit. A simple building like the tea-room was a manifestation of that spirit. *"The simplicity of the tea-room and its freedom from vulgarity make it truly a sanctuary from the vexations of the outer world"*. This means that a tea-room is not only an architectural thing but a spiritual place that gives peace of mind.

Chapter 5 explains art appreciation. In this chapter, the author provides instructions on how to see and feel art. Art appreciation means that *"Our mind is the canvas on which the artists lay their colour; their pigments are our emotions; their chiaroscuro the light of joy, the shadow of sadness. The masterpiece is of ourselves, as we are of the masterpiece."* Okakura was an art specialist and argued that the true meaning of art was that the artist and the viewer sympathized and communicated with each other through the artwork. He thought that it was important that the artist and viewer both humbly control the other. In art, *"It is rather the soul rather than the hand, the man rather than the technique, which appeals to us".* Okakura had the same ideas about the tea ceremony in that it could not be realized by either the owner or the customer alone. It would be realized only when both parties came together with the attitude of collaborative work. In this chapter, he laments that the public demand only the most popular items, regardless of their judgment. He felt shame about a boom to choose something that suited fashion rather than a true beauty when the boom was the same at all times.

Chapter 6 explains flowers. Okakura expressed that *"surely with mankind the appreciation of flowers must have been coeval with the poetry of love"*. Flower arrangement in Japan was born in the 15th century in line with the concept of the tea ceremony. The first flower arrangements were made by Buddhist monks who gathered flowers after a storm in a container while thinking in terms of an endless sympathy for living things. In the tea ceremony, the flower arrangement is an essential part of the decoration. Therefore, flashy flowers are kept out of the tea room. When a tea-master arranges a flower, *"nothing else will be placed near it which might interfere with its effect, not even a painting, unless there be some special aesthetic reason for the combination"*. The attitude toward flowers demonstrated culture, and Japanese people expressed their unifying feelings about nature through flowers. The flowers would always fall at the end. Japanese people knew that this was nature, and saw an ephemeral beauty in cherry blossoms, which is the most popular flower in Japan.

Chapter 7 introduces the life stories of the tea-masters. Tea-masters are specialists who managed the tea ceremony. However, they were not only specialists but also contributors to art. *"The tea-masters held that real appreciation of art was only possible to those who made of it a living influence"*. This means that the tea-masters thought that they could truly enjoy art only by putting art into their daily lives. The tea-masters contributed to the style of architecture of the tea-room, castle, palace, and other wooden architectures from the 16th century onwards. Japanese gardens, as well all the famous gardens in Japan, were designed by tea-masters. Pottery design was also developed by the tea-masters, as well as

many famous textiles, which were named after the tea-masters who had invented the colours and patterns. No matter what kind of art the Japanese pursued, there was no evidence of their talent. Japanese people could feel the existence of a tea-master in their daily lives. For instance, how to cook and wear plain clothes. Through the tea-masters, Japanese ware taught the beauty of being humble and respecting innate simplicity. Thus, Japanese lifestyles were created by tea-masters.

At the conclusion of this chapter, Okakura introduces the death of a famous tea-master. *"The Last Tea of Rikyu"* was a well-known story handed down as the ultimate in tragic greatness. Rikyu, a great tea-master of the 16th century, was highly trusted by the politicians of the time. The enemies of Rikyu, who were jealous of him, spread a lie of the alleged assassination of a politician by the hands of Rikyu. For this reason, Rikyu was innocently required to kill himself. In ancient Japan times in the 16th-century Samurai era, suicide was an honour, as a testimony to a respectable man. When the day came that he had to die, he conducted the last tea ceremony, with only a few close people. Afterwards, he killed himself and went to heaven. For Rikyu, death was the last part of life and a supreme art. Okakura advocated that only those who had lived beautifully could die beautifully.

The Book of Tea thus closes with the ultimate unity between humans and nature. Throughout the book, the audience finds that the idea of the tea ceremony influences all facets of Japanese life, even for those who are unfamiliar with tea. There is another classic essay about Japanese culture for a Western audience written in English, named *"Bushido: The Soul of Japan"* (Nitobe 1900). It was published in 1900 in California, by Nitobe Inazo. In this

book, Nitobe argues that the Samurai spirit that acts boldly even he sacrifices himself for the cause is the root of the morality of the Japanese culture, and provides the imagery of a Samurai country to the West. Conversely, Okakura argues in his book that there is a deeper culture than fight and death. Tea led to peace and life for Japanese people. In the era of war, the Japanese military tended to admire the old Samurai spirit as fight and death. However, in the era of peace, people prefer to think about culture. For the younger generation or foreigners, knowing the existence of the tea ceremony is the way to understanding Japanese culture quickly.

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- Original/Research Paper 2,

- Original/Research Paper 3,

- Original/Research Paper 4,

- Original/Research Paper 5,

- Policy Paper, and

- Book Review.

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Calfee, R. C., & Valencia, R. R. (1991). APA guide to preparing manuscripts for journal publication. American Psychological Association.

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Author, A. A. (Year of publication). Title of work. [Ebook]. Publisher.

Nondatabase URL

De Huff, E. W. (n.d.). Taytay's tales: Traditional Pueblo Indian tales.

Print Journal Example

Author, A. A., Author, B. B., & Author, C. C. (Year). Title of article. Title of

Periodical, volume number(issue number), page range.

Harlow, H. F. (1983). Fundamentals for preparing psychology journal articles.

Journal of Comparative and Physiological Psychology, 55(2), 893-896.

Online Journal Example

Author, A. A., & Author, B. B. (Date of publication). Title of article. Title of

Journal, volume number(issue number), page range.https://doi.org/

Brownlie, D. (2007). Toward effective poster presentations: An annotated

bibliography. European Journal of Marketing, 41(3), 1245-

1283. https://doi.org/10.1108/03090560710821161

Print Magazine Example

Cite like a print journal article, but give the year and the month for monthly

magazines. Add the day for weekly magazines.

Henry, W. A., III. (1990, April 9). Making the grade in today's schools. Time,

135, 28-31.

Online Magazine Example

Cite like a print magazine article, except: a) no page numbers, and b) add a

DOI (preferred) or full URL.

Auerback, M. (2019, January 27). In antitrust, size isn't everything.

Salon. https://www.salon.com/2019/01/27/in-antitrust-size-isnt-
everything_partner/

Online Newspaper Example

Cite like an online magazine article except that in most cases, you'll include

a URL because no DOI will be available.

Author, A. A. (Year, Month Day). Title of article. Title of Newspaper. URL

Parker-Pope, T. (2008, May 6). Psychiatry handbook linked to the drug

industry. The New York

Times. https://well.blogs.nytimes.com/2008/05/06/psychiatry-handbook-linked-to-drug-industry/

Website Example

Author, A. A., & Author, B. B. (Date of publication). Title of page. Title of Website. URL

Martin Lillie, C. M. (2016, December 29). *Be kind to yourself: How self-compassion can improve your resiliency*. Mayo Clinic. https://www.mayoclinic.org/healthy-lifestyle/adult-health/in-depth/self-compassion-can-improve-your-resiliency/art-20267193 Cleveland Clinic. (2019, July 16). *Stress: 10 ways to ease stress.* https://my.clevelandclinic.org/health/articles/8133-stress-10-ways-to-ease-stress

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Student Research: " Innovative research on shampoo and dishwashing detergent made from Kapok leaves"
Faculty Research : " The Approval of Higher Education Improvement Project (HEIP) Research Project Round II"

Editorial

The importance of research policy at higher education institutions in Cambodia

Original Papers

The impact of international remittances from migrant workers in South Korea on the livelihoods of rural Cambodian households : A case study of Pea Reang District, Prey Veng Province
Transparency, accountability and stakeholder engagement in budget utilization programs at public universities in the Kingdom of Cambodia
The Standard Khmer vowel system: An acoustic study
Factors influencing the reduction of plastic bag consumption in Cambodian supermarkets
Vulnerability to changing climate : Locating smallholder farmers coping strategies in drought prone districts of Cambodia and Nigeria

Policy Paper

Enhancing Quality of Life through Sustainable Urban Transformation in Cambodia : Introduction to the Build4People Project

Book Review

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