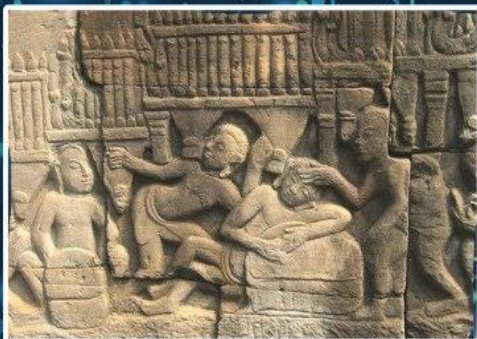
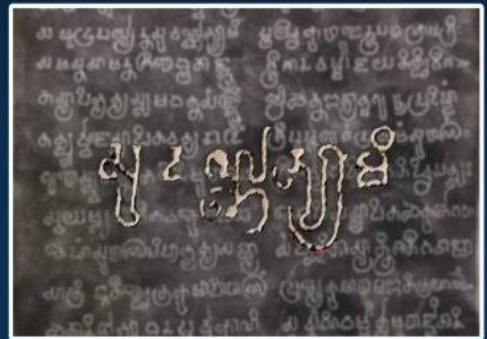




Insight

Cambodia Journal of Basic and Applied Research



Insight

Cambodia Journal of Basic and Applied Research (CJBAR)

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News

Higher Education Improvement Project (HEIP) activities have been funded by an IDA Credit, equivalent to 90.0 million USD, as well as a 2.5 million USD contribution from the Government of Cambodia. The project will be implemented over a 6-year period—starting in July 2018 and ending in June 2024. The Project Development Objective (PDO) of the HEIP is to improve the quality and relevance of higher education and research in the STEM and Agriculture fields at target higher education institutions (HEIs), as well as to improve governance of the sector. As part of Component 2 of the HEIP project, “Improving Research in STEM and Agriculture”, the Royal University of Phnom Penh has been granted 4.3 million USD to assist researchers and faculty members to conduct and publish scientific research in international peer-reviewed journals.

These research projects aim to realise the vision of RUPP becoming 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: (1) Research for industry; (2) Research for policy making; and (3) Frontier research. In early 2020, the HEIP approved eight research projects across different faculties at the Royal University of Phnom Penh (RUPP) with a total budget of 828,926 USD.

Research Project 1

Research Topic: Innovative solutions for improving the quality of drinking water and community water supplies in rural Cambodia

Duration of the Sub-project: 3 years

Total Cost of the Sub-project: 59,000 USD

Research Team: Dr. Chan Oeurn Chey (Principal investigator), Dr. Phan Kongkea (Member) and Dr. Sao Vibol (Member)

This project will focus on water quality monitoring and the development of innovative solutions for improving drinking water quality used to source community water supplies in rural Cambodia. It will be conducted in climate prone areas within the coastal zone (Kep, Kampot, Sihanoukville and Koh Kong) and areas surrounding the Tonle Sap (Kampong Chhnang, Pursat, Battambang, Siem Reap and Kampong Thom). Drinking water sources (n =50) and community water supplies (n=10) from each province will be sampled at random. Groundwater samples will be collected from a tube wells 5-10 minutes after flushing to remove any standing water. A grab sampler will be used to collect water from hand-dug wells. Water samples will be collected in two polyethylene bottles for different analytical purposes. Raw samples will be analyzed for F⁻, NO₃⁻ and NO₂⁻. Acidified water samples will be analyzed for As, Ba, Cu, Fe, Mn and Zn. Simultaneously, on-site measurement of water temperature, pH, ORP, conductivity, total dissolved solids (TDS), salinity, dissolved oxygen (DO) and turbidity will be conducted. Water samples will be also collected from water treatment facilities and at the point-of-use in households within each province by the same approach.

It is expected that approximately 500 water sources including well, ponds and canals 100 water supply plants in the study area will be tested for water quality and contaminants of concern. The will result in more effective monitoring and management of water quality in rural Cambodia. Concurrently, treatment technologies will be developed to remove heavy metals and other contaminants of concern using locally available and low-cost

materials. It is expected that these technologies will provide sustainable solutions to the provision of drinking water in this context.

Research Project 2

Research Topic: Study on urban climate resilience and mitigation in Phnom Penh, Siem Reap, and Preah Sihanouk provinces

Duration of the Sub-project: 4 years

Total Cost of the Sub-project: 161,700 USD

Research Team: Dr. SEAK Sophat (Principal investigator), Dr. SPOANN Vin (Co-investigator), Mr. Khan Lyna (Member) and Mr. Phat Chandara (Member)

This project will conduct a comparative study of urban resilience and mitigation in the cities of three provinces in Cambodia including Phnom Penh, Siem Reap and Preah Sihanouk. It aims to address the knowledge gap in mainstreaming climate resilience and mitigation measures into the planning and implementation of development projects used for the protection of urban ecosystems in Cambodian cities. This research will use participatory approaches as part of the Hazard, Infrastructure, Governance, Socio-economic characteristics (HIGS) framework.

This project will draw upon best practice approaches to achieving urban resilient measures for infrastructure, water resources, and governance; and propose new adaptation and mitigation planning and implementation modalities. Knowledge products such as policy briefs, posters, booklets, manuals and TOT materials on urban climate resilience will be developed for policy makers, urban planners, academics, researchers, and practitioners to build sustainable and resilient cities. More significantly, this research will provide specific recommendations to assist in the responses to climate

change. These recommendation may be used by concerned ministries as a baseline for developing specific adaptation and mitigation plans—that are linked to the current climate hazards in Cambodia. Beyond this general research objective, the study also aims to meet three specific objectives:

Objective 1: To identify the city areas that are most vulnerable to climate change impacts and disaster risks, with respect to urban ecosystems of Phnom Penh, Siem Reap and Preah Sihanouk;

Objective 2: To assess climate change impacts on urban ecosystems in the urban areas of three provinces in Cambodia and develop adaptation plans to better cope with these impacts; and

Objective 3: To identify appropriate adaptation and mitigation mechanisms and provide policy recommendations that response to climate change impacts on urban ecosystems.

Research Project 3

Research Topic: Monitoring seasonal variation in metal (As, Cd, Cu Fe, Pb and Zn) concentrations in vegetables, rice and their relation to surface water and soil along the Mekong River, Cambodia

Duration of the Sub-project: 4 years

Total Cost of the Sub-project: 354,118 USD

Research Team: Dr. Proum Sorya (Principal investigator), Mr. Sean Vichet (Member) and Mr. So Viccheka (Member)

Normal fertilizer and pesticide application practices used to improve agricultural products, may contribute to the accumulation of metals in soil-water systems and agricultural products in Cambodia. These concentration levels depend on the geological characteristics of soils and amount of inputs

used. The general objectives of this study to examine the metal concentrations of As, Cd, Cu, Fe, Pb, and Zn in rice and vegetables, as well as in soil and surface water resources along the Mekong River. These results will be analyzed to better understand current pesticide and fertilizer application practices and their effect on the environment, aligned with informing sustainable management strategies for agricultural products and soils. The aim of this project is to provide atypical technical support to the Rural Entrepreneurship and Market Inclusion in Cambodia (REMIC) project; and Japan Farm Products Cambodia to assist with the safe development of sustainable products. The research team will work on analytical techniques to monitor the effect of metal levels on the environment; especially as this relates to food and agricultural products and the application of fertilizer and pesticides. It intends to determine the degree of certainty related to safe levels of human consumption for specific agricultural products.

As part of implementing this assessment, the project will provide product safety certification to companies on the basis serial laboratory analyses, which may be used to promote public confidence about the quality of agricultural products for marketing purposes. The research team will provide at least one training event per year linked to the results of these analyses. These will be presented as scientific seminars transferring science to farmers in communities to provide advice about the status of metal pollutants in surface water and soil resources; how this affects agricultural products, and best practice pesticide and fertilizer application procedures to ensure long-term product sustainability. The research has three main specific objectives:

Objective 1: To establish a national baseline of novel metal baseline levels that monitors the environmental impact of pesticide and fertilizer application along the Mekong River and whether this demonstrates local or seasonal variation. This will enable a better understanding of impacts of agricultural practices on ecological communities. This date will be used as a primary reference point for future research on the complexity of metal biomonitoring in South East Asian riverine systems;

Objective 2: To assess the safety levels of these metals with respect to permitted WHO/FAO/National Guidelines and better understand current pollution levels and the potential consequences with respect to human consumption and environmental degradation

Objective 3: To understand the effect of current practices of pesticide and fertilizer application on agricultural land and how to improve recommended land management practices.

Research Project 4

Research Topic: A multiscale Heston's stochastic volatility model with a stochastic interest rate

Duration of the Sub-project: 3 years

Total Cost of the Sub-project: 41,330 USD

Research Team: Dr. Sotheara Veng (Principal investigator), Dr. Sony Chan (Member), and Dr. Ji-Hun Yoon (Member)

In this research, we extend the multiscale Heston stochastic volatility model outlined in Fouque and Lorig (2011) by incorporating a stochastic interest rate. This will be used to study European option pricing and portfolio optimization problems. To this end, the specific objectives are as follows:

Objective 1: To formulating a multiscale Heston's stochastic volatility model with a stochastic interest rate in which analytic tractability is retained for European option pricing and portfolio optimization problems;

Objective 2: To seek approximate solutions of partial differential equations for European option prices under the proposed model using asymptotic analysis;

Objective 3: To apply a Monte-Carlo simulation to obtain an actual option price, which will be used as a benchmark for comparison purposes;

Objective 4: To analyze the error between an approximate solution and the actual option price, resulting from the Monte-Carlo method;

Objective 5: To calibrating the theoretical price to real market data, through implied volatility fitting to see whether the formulated model really outperforms the existing one;

Objective 6: To seek an approximate solutions for the value function for portfolio optimization, under the proposed model by using asymptotic analysis;

Objective 7: To obtain explicit optimal control for the value function. Our multiscale Heston's stochastic volatility model with a stochastic interest rate is expected to outperform the constant interest rate model of Fouque and Lorig (2011) in terms of implied volatility fitting, particularly, for short time-to-maturity European options.

Another expected result is that the tractability in Heston's model is retained to a certain level. In other words, the closed forms for approximate solutions for European option prices and value functions will still be available in the stochastic interest rate setting. One of the main outcomes of this

research is the scientific publication of two to three papers. Another is the graduation of two master students in financial mathematics. Finally, the results of this study will be helpful for the Cambodia Securities Exchange (CSX) in terms of the expansion of traded products in the near future.

Research Project 5

Research Topic: Strongly coupled field theory from the point of view of holography

Duration of the Sub-project: 3 years

Total Cost of the Sub-project: 44,040 USD

Research Team: Dr. Sunly Khimphun (Principal investigator)

The application of string theory is an important for the study of Physics as it is a promising candidate for explaining quantum gravity. One approach to support such a theory is to construct a model to investigate physical phenomena. Thus, this project is related to model simulation. Despite the novelty of our model, results will be simulated with conditional inputs and real data constraints, particularly with respect to Objective 3 below, relating high energy physics, to low energy physics. The simulation will test the Holographic principle, which is one of the applications in String theory postulated to explain the unification between gravity and quantum theory, via existing physical phenomena and real cosmological observation. The construction of this model is essential to understanding and fulfilling the theory, which is academically important for the advancing fundamental scientific concepts.

Objective 1: To study a model of interest, such as Einstein-Maxwell-Field, Massive Gravity, and $f(r)$ gravity theory in an (an)isotropic medium. These

three models will be investigated in terms of their background solutions to equations of motion. The solutions will be produced numerically, then compared and analyzed.

Objective 2: To study the transport coefficients associated with the models of interest. Most of the results for transport coefficients will be numerically computed using a computer simulation. The results will be analyzed based on physical grounds to justify the numerical reliability and physical interpretations.

Objective 3: To compare optical properties as a consequence of the model of interest, with experimental results. The results of this framework will be based on a non-conventional picture, but are expected to play some role in depicting the qualitative behavior of some physical phenomenon as part of a real experiment.

Objective 4: To apply five-dimensional gravity theory and AdS/CFT correspondence to construct a holographic cosmology to study the expansion of the universe. The model constructed will be tested against the real observable data. A good agreement between the model and this data is expected.

Research Project 6

Research Topic: Elaboration of mixed oxides ($\text{TiO}_2\text{-M}_x\text{O}_y$) for photocatalytic applications

Duration of the Sub-project: 3 years

Total Cost of the Sub-project: 110,270 USD

Research Team: Dr. Cheng Khley (Principal investigator), Dr. Long Solida (Member), Dr. Tieng Siteng (Member), Dr. Chey Chan Oeurn (Member), Ms.

Seng Samphors (Member), Ms. So Vichheka (Member) and Ms. Houy Laingsunh (Member)

According to Yale and Columbia University researchers, Cambodia's Environmental Performance Index demonstrates poor results for water and air pollution, as well as bacterial outbreaks. These problems need to be addressed. An inexpensive photo-catalyst, TiO_2 , which possesses good photo-stability, nontoxicity, and high reactivity may lead to potential solutions. Recently, mixed metal oxides of $\text{Zr}_x\text{Ti}_{1-x}\text{O}_2$ of different compositions ranging between 0 and 100% Zirconium (Zr) concentrations were tested by Cheng et al. at both the nanoparticle and crystalline stages. Following this comparison, selected compositions were used as photocatalytic materials to decompose ethylene in a gas phase, resulting in results that were up to two times better. Other applications of this photo-degradation process may be applied to the liquid phase for killing bacteria. Thus, it is important to conduct further studies on these material to demonstrate whether improved catalyst efficiency may be realised.

The research will be conducted by synthesizing mixed metal oxide nanoparticles from precursors, then investigating the nucleation-growth kinetics using hydrodynamic light scattering techniques. The prepared nanoparticle powders will be characterized using AAS, ICP, thermal analysis, X-ray diffraction and electron microscopy. The results from characterization will determined the real compositions, homo- and heterogeneities and morphologies of the synthesized materials. $\text{TiO}_2\text{-M}_x\text{O}_y$ in the form of a powders and film may be coated onto substrates such as glass beads and used

to decompose of model pollutants in liquid and gas phases using photocatalysis to kill bacteria. Thus, the project has the following objectives:

Objective 1: To synthesize, analyze, and characterize $\text{TiO}_2\text{-M}_x\text{O}_y$ prototypes with different metal oxides (Zirconium, Vanadium, Copper, Iron, and Tungsten)

Objective 2: To compare the decomposition capacity of $\text{TiO}_2\text{-M}_x\text{O}_y$ nanoparticles on model pollutants

Objective 3: To compare the decomposition capacity of $\text{TiO}_2\text{-M}_x\text{O}_y$ nanoparticles on pollutants in controlled matrix conditions and real conditions (waste from food factories and hospitals)

Objective 4: To compare the antibacterial capacity of $\text{TiO}_2\text{-M}_x\text{O}_y$ nanoparticles on selected priority pathogens such as *Escherichia coli* and *Salmonella* spp.

Objective 5: To develop substrate prototypes required for commercial applications of nano-materials such as coated substrates (glass beads, glass plates, or aluminum) in the long term.

Objective 6: To test the photocatalytic activity of substrate prototypes on representative organic and biological wastes in liquid phase from selected sites.

Research Project 7

Research Topic: Biodiversity research for sustainable development in particular reference to bats

Duration of the Sub-project: 4 years

Total Cost of the Sub-project: 16,000 USD

Research Team: Dr. Ith Saveng (Principal investigator), Mr. Samorn Virak (Member), and Mr. Sin Sopha (Member)

Bats are the second most diverse taxa after rodents, comprising 18 families, 202 genera and more than 1,116 species worldwide (Simmon, 2005). Bats play a very important role in the ecosystem and greatly benefit humans. Fruit bats are seed dispersers. Insectivorous bats control insects that can dramatically reduce the number of crop pests. The cave nectar bat is the main pollinator of high value fruit and other important plant species. Bat guano functions as a source of energy for invertebrate diversity in caves, contributing to their ranking as significant biodiversity hotspots in terms of its endemism and threats (Whitten 2009). Moreover bat guano is used as fertilizer in many highly profitable plantations in Cambodia.

Despite this, only limited research has been conducted on bat conservation in Cambodia, especially when compared to neighboring countries such as Vietnam, Thailand and Laos. This Cambodia possesses only limited knowledge on bat diversity, ecology and ecosystem services. This project aims to build an up-to-date species database; developing a research culture and capacity bat conservation awareness; as well as developing strategies for the conservation of bat species in Cambodia.

Objective 1: To conduct a Cambodian bat diversity assessment

Objective 2: To produce a valid bat checklist and bat species distribution map

Objective 3: To build capacity and promote bat conservation awareness

Objective 4: To identify bat conservation priority areas and propose a sustainable development framework for bat conservation in Cambodia

Objective 5: To initiate ecological questions and experimental designs on ecosystem services for bats for future studies including, pest control and pollination.

Research Project 8

Research Topic: Develop a highly sensitive, speed, resolution, and compact interferometer for precision optical sensor applications

Duration of the Sub-project: 3 years

Total Cost of the Sub-project: **82,104 USD**

Research Team: Dr. Eang Seang Hor (Principal investigator), Prof. Kyunman Cho (Member), and Mr. Hang Sim (Member)

In Cambodia, there is no interferometer devices for the precise measurement of refractive index changes, surface irregularities, topography and weight; for extensive application in all branches of science, technology and medicine. Most material characterization, biosensor and surface topography devices in Cambodia are imported. Additionally, there are few experts in the country capable of using these devices and only limited knowledge of high sensitivity optical sensors such as interferometer devices. Thus, the general objective of this research is to develop new interferometers for super resolution optical scanning microscopy, high-sensitivity fluidic channel readouts, and high sensitivity weight measurement for use by laboratories and industry.

This includes checking chemical and bacteria concentrations, low weight measurement, and 3D surface structure characterization. This will also contribute to strengthening and improving scientific research capacity within higher education institutions in Cambodia and equip graduates with transferable skills and knowledge that may be applied to other technical challenges. This technical capacity may also be transferred to the private sector through training, workshops, and conference presentations. With a

view to achieving general objective above, we will focus on the list of specific objectives below.

Objective 1: To design three new interferometer devices to be used for scanning standard samples to measure concentration, and microscale weights and improve the resolution quality, sensitivity, and precision or measurements previously possible in scientific research using results from commercial devices.

Objective 2: To transfer this technology to the private sector through presenting this research workshops and international conferences. The private sector participate in these events to examine our research findings with the purpose of identifying the potential opportunities for research collaboration and/or commercialization. The private sector may opt to send their staff to support the installation of a photonics laboratory at RUPP and provide internship opportunities for students within our research team.

Objective 3: To use these new devices as prototype optical sensors for research purposes within the university to better understand surface topography, refractive index detection, low concentration solution sample detection, bio-material reaction detection, and very low weight measurement.

Dangers and opportunities related to the COVID-19 pandemic for Higher Education Institutions in Cambodia

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The COVID-19 pandemic has caused the immediate closure of Higher Education Institutions (HEIs) globally, as experts in public health have recommended social distancing to reduce infections and total deaths (Murphy, 2020). It had been suggested that students from developing countries will be more severely affected than others. In these countries, governments find it challenging to assist lecturers to provide remote learning opportunities (Room to Read, 2020). This sudden spread of COVID-19 has had catastrophic impacts that have damaged the function of HEIs via long-term disruptions to educational programs. Closures of HEIs have been implemented to reduce interpersonal contact between students to reduce community transmission of the virus. This has the potential to spread quickly in densely populated university campuses (Weeden & Cornwell, 2020) and has placed greater financial pressure on HEIs at a time when funding is already in decline. Consequently, the integrity and accountability of these institutions will be of increasing importance both during and after the COVID crisis (Blankenberger & Williams, 2020).

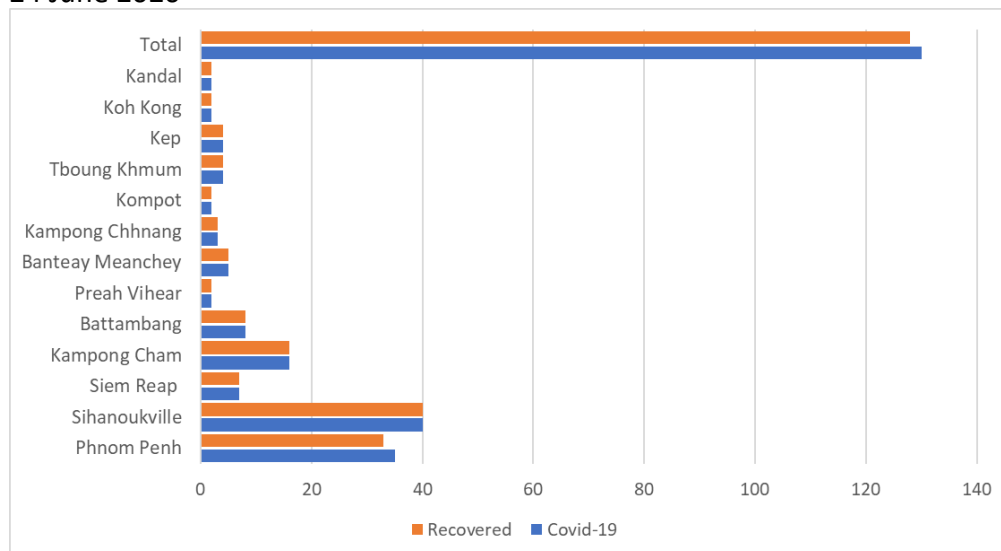
The pandemic started in the Chinese city of Wuhan in Hubei province and was first detected in December 2019 (Huang et al., 2020). According to World Health Organization, there were 8,708,008 cases of the disease and 461,715 deaths to 21 June 2020¹. Cambodia first recorded a case on 27 January in a Chinese national. By the 24 June 2020, 130 cases had been recorded. Most cases were detected in Sihanoukville (30.8%), followed by Phnom Penh (26.9%), and Kampong Cham (12.3%). The World Bank 2020 Cambodia Economic Update suggests that the economic crisis resulting from COVID-19 poses one of the greatest threats to socio-economic development in Cambodia experienced over the past 30 years. The three most affected sectors will be tourism, manufacturing, and construction; which in 2019, prior to the pandemic, contributed more than 70% of economic growth and 39.4% of total paid employment in the country.

The COVID-19 outbreak has attracted significant public interest in Cambodia and is more than a global public health crisis. It has also been a crisis for socio-economic development and the education sector. The pandemic has placed experienced educators in a difficult situation, as they are required to continue their role, while their students are required to stay at home (UNESCO, 2020). The Ministry of Education Youth and Sport (MoEYS) announced a nationwide closure of public and private HEIs in response to the global pandemic on 16 March 2020. Over recent decades, Cambodia has focused on providing educational services in a traditional university

¹ See the detail:https://covid19.who.int/?gclid=CjwKCAjwrcH3BRAp_EiwAxiDPTWYV_NviDnDvKrRKu2_FEY_etOh2rl_3EY1ITL0kJZ9LsT7e_GYBvaY7xoC72UQ_AvD_BwE.

classroom; however, the spread of COVID-19 has required a rapid transition to distance and online learning.

Figure 1. COVID-19 infections and recoveries in Cambodia, by province, as of 24 June 2020



Source: Ministry of Health²

In Chinese language, the term *crisis* comprises two characters; one representing danger, and the other opportunity³. If COVID-19 is a crisis, online and distance learning is a significant opportunity for Cambodia. The first distance education course in the world was developed by Sir Isaac Pitman in the 1840s, who instructed students using a system of shorthand, mailing texts transcribed on postcards. In turn, he received transcriptions, which he corrected. Student feedback was a crucial element of Pitman's innovative

² See detail <https://covid19-map.cdcmoh.gov.kh/?fbclid=IwAR1bUkORz06mJdd5NVNAXu9XC0136W XodXYnt yHNB uPn63gzXsCRgzNSNQ>.

³Speeches by President Kennedy at United Negro College Fund fundraiser, Indianapolis, Indiana, 12 April 1959, and Valley Forge Country Club, Valley Forge, Pennsylvania, 29 October 1960.

system and resulted in the introduction of uniform postage rates across England (Tait, 2003). The term online learning was first used in 1995 when the web-based system, WebCT, was developed. This Learning Management System (LMS) later became known as Blackboard and was primarily used to upload text and pdf documents online (Bates, 2014). Today, a broader range of terms including e-learning, blended learning, on-line education are also used (Singh & Thurman, 2019).

In response to the crisis, the Royal University of Phnom Penh (RUPP) has strategically maneuvered its offerings during the *new normal* by ensuring its core services continue to be provided online. RUPP has quickly adopted distance learning as a way to ensure the students do not miss classes. Never before have information and communication technologies (ICTs) played such a crucial role. However, when the Faculty of Education applied digital and distance learning, while many students were quick to adapt, challenges emerged within two programs offered by the Faculty of Education. Specifically, this included the School Leadership Upgrading Program (LUP) and Teacher Upgrading Program (TUP). Many students in these programs had limited ICT skills. To cope with this situation, the Faculty of Education developed a 3-credit point course entitled *Digital Distance Learning and Teaching Management*. This course aimed to equip learners with digital distance learning and teaching competencies to adapt their teaching learning practices at two levels—at the university, so prospective teachers may continue to learn—and at secondary schools so that teachers may continue to teach.

Due to limited resources, these programs use free open source technologies to ensure greater accessibility. The Google suite of products, Facebook, and Telegram were selected, with trainee teachers expected to use these in their schools. The key modules of the program included (1) creating and managing a digital account; (2) creating and managing real-time meetings; (3) administering a digital classroom; (4) data management for teaching and learning; and (5) distance learning and teaching management systems. As a result of this initiative by the Faculty of Education at RUPP, the MoEYS issued Guidance No. 30, directing all schools to utilize open source software such as the Google Suite for distance teaching and learning.

The course was delivered to 162 principal students within the School Leadership Upgrading Program (LUP) during May 2020; and 768 teachers completing the Teacher Upgrading Program (TUP) during June 2020, across 100 target secondary schools. The course started with the basics of creating a Gmail account and continued to cover aspects such as creating a Google classroom and managing Google drives. Before this training, many studies have no prior knowledge of how to create a Gmail account or how to install apps on a smartphone. Patience and time invested were required for students to practice with trainers and assistants as the course progressed. It was important for the training team to guide them, using tools such as screen sharing.

From this basic starting point, approximately 50% of the trainees were able to demonstrate competency in using Google meet, Google classroom, Google drive, Google slides, and Google forms as part of a teaching and learning platform at each school. However, many trainees with low digital

literacy suffered from making use of these platforms for online and distance learning challenging. The training team will continue to assist them until they are able to successfully implement this initiative. Despite the challenges, a significant benefit has emerged from the COVID-19 pandemic, via the creation of an ideal environment for students, teachers and school administrators to embrace digital literacy as a means to deliver learning outcomes. While social media and open source ICTs have been available for a long time, their potential benefits have not been taken seriously until now.

The *new normal* has enabled school administrators to quickly implement ICTs for their education programs and finance them in such a way that they are incorporated across the entire system. This can be a cause for alarm among teachers, who learn that if they do not know how to make use of ICTs for education, they will not be able to thrive in the context of modern teaching and learning practices. This has encouraged them to quickly upskill so they may remain relevant and useful. Parents also realize the benefits of ICT for education beyond their use for entertainment and basic communication. However, it is students who need to pay most attention to these changes. Their future studies will greatly benefit from these technologies. In summary, the COVID-19 crisis has been a major wake-up call in Cambodia, in terms of having a clearer vision about the use of ICTs for education.

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The integration of renewable energy sources and IoT devices as a future sustainable energy solution

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សង្ខេប

បច្ចុប្បន្ននេះ ការផ្គត់ផ្គង់ថាមពលអគ្គិសនីនៅប្រទេសកម្ពុជានៅមានការខ្វះខាតនៅឡើយ។ ការខ្វះខាតនេះបណ្តាលមកពីការផលិតថាមពលមិនទាន់គ្រប់គ្រាន់ និងការប្រើប្រាស់ថាមពលអគ្គិសនីមិនទាន់មានប្រសិទ្ធភាពខ្ពស់នៅឡើយ។ ការស្រាវជ្រាវនេះមានគោលបំណងដោះស្រាយបញ្ហានេះតាមរយៈការរៀបចំប្រព័ន្ធអគ្គិសនីតាមផ្ទះនិងតាមអាគារនានាដោយប្រើបន្ទះសូឡាដែលមានកុងតាក់អាចគ្រប់គ្រងការប្រើប្រាស់ថាមពលអគ្គិសនីពីចំងាយដើម្បីសន្សំថាមពល។ ប្រព័ន្ធថ្មីនេះរួមមានបន្ទះសូឡា on-grid បណ្តាញអគ្គិសនីដែលមានតាមផ្ទះស្រាប់ ប្រព័ន្ធនានាសម្រាប់ប្រមូលទិន្នន័យ និងប្រព័ន្ធកុងតាក់ online។ លទ្ធផលពិសោធបានបង្ហាញថា បន្ទះសូឡា 130-watts មានសមត្ថភាពផលិតថាមពលអគ្គិសនីបាន ១៧៦.៩៦kWh ក្នុងមួយឆ្នាំ ដែលសមាមាត្រទៅនឹងថវិកាប្រមាណ១៣២,៧២០.០០រៀល ហើយប្រសិនបើឧបករណ៍ IoT ត្រូវបានប្រើសម្រាប់គ្រប់គ្រងការប្រើប្រាស់ថាមពលអគ្គិសនី វានឹងអាចជួយសន្សំថាមពលបានមួយកម្រិត

ទៀត។ របៀបថ្មីនេះផ្តល់នូវភាពងាយស្រួលក្នុងការប្រើប្រាស់ថាមពល ស្អាត និងនាំមកនូវអត្ថប្រយោជន៍នានាផ្នែកសេដ្ឋកិច្ច បរិស្ថាន និង សង្គមទៀតផង។

Abstract

Cambodia still faces significant constraints in supplying adequate electricity to its citizens. Currently, energy shortages tend to derive from both limited energy generation and inefficient energy consumption. This research explores alternatives to this situation via the use of innovative technologies. It seeks to integrate solar panels with energy grids in buildings, equipped with online switches for controlling these systems, to save energy. The proposed system uses a combination of on-grid solar systems, the existing grid, systems for data collection, as well as online switches. An experimental model was used to demonstrate that a 130-watt solar panel has the capacity to generate 176.96 kWh per annum, equivalent to 132,720 KHR; if used with IoT devices to collect data to efficiently control the system. This innovative approach enables easy access to clean energy, leading to benefits for the economy, environment and society.

Keywords: on-grid solar systems, SMART grids, online switches

Introduction

Energy consumption in Cambodia is increasing due to population growth and economic development. Current electricity shortages affect economic activities, social development and wellbeing. Sufficient electricity is required to support the development of many industries, including small to medium enterprises (SMEs) in the textile and agricultural sectors. According to Cambodia Basic Energy Plan, 2019, the electricity demand increased by 18% per year and the power generation increased by 19% per year between 2010 and 2016. The Cambodia Energy Outlook also reports that its electricity

demand will increase by 7.5 times between 2015 and 2040. To maintain affordability and security, the Basic Energy Plan of Cambodia recommends that the power generation mix in 2030 should be 35%, 55%, and 10% of coal, hydropower and renewable energy, respectively (ERIA, 2019).

Even though, energy demand in Cambodia has gradually increased with economic development, this has negatively impacted the environment. Moreover, between April and May 2018, Cambodia faced significant energy shortages as a result of low dam levels, with existing hydropower stations producing only 30% of their regular output (CDC, 2019). Additionally, there was increased energy consumption in households via greater use of electrical appliances. In response, the Ministry of Mines and Energy (MME) planned the delivery of a range of infrastructure projects by 2020; including a 20 MW solar system in Kampong Speu, a 30 MW system in Pursat, a 60 MW system in Battambang, a 30 MW in Banteay Meanchey; as well as a 400 MW coal-fired power station (CDC, 2019).

Electricity shortages affect the living conditions and livelihoods of Cambodian people. This problem is partially linked to inefficient energy consumption. For instance, many household users do not switch off circuit breakers when they leave buildings. Moreover, renewable energy sources, such as solar-voltaic systems may be capable of meeting some of the unmet demand in Cambodia; but they are expensive and require an improved capacity in the country to implement them. Advanced technologies such as SMART meters, which gather energy consumption data, connected to on-grid systems may result in further benefits, such as reduced CO₂ emissions.

This research examines how solar on grid systems may take advantage of the weather conditions in Cambodia more effectively by using the combination of solar on grid and smart controlling online switches. It proposes the measurement of consumption data to develop strategies for saving energy. Specific objectives include: (1) integrating solar energy with a centralised grid; and (2) the collection of data using IoT smart devices for controlling electricity use via online. It is assumed that this system will improve access to clean energy for the benefit of the economy and society.

Literature Review

New technologies are required to respond to needs for electricity in every sector in Cambodia. Photo-voltaic systems have the potential to be quite useful and powerful, as other energy sources have a significant environmental impact. Enhancing the efficiency of energy consumption with IoT devices has the potential to make solar equipment more effective and improve the quality of life of people in Cambodia. Among IoT applications, smart homes are expected to have the most significant potential in the near future (Shuhaiber, 2018). Over the past few years, cloud computing initiatives have been used to collect data to be used for intelligently managing energy consumption in buildings (Khan et al., 2017). Technology upgrades, such as smart home appliances have been used to help facilitate this, using mobile phones to remotely control energy consumption.

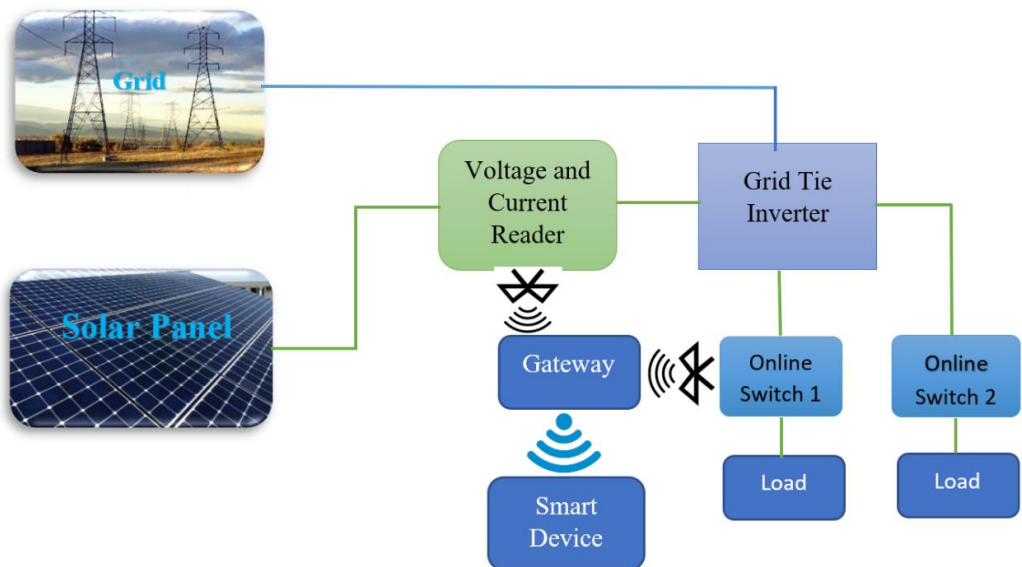
The use of big data and cloud computing to monitoring energy consumption through sensor management, IoT devices, and smart phones has become increasingly significant (Plageras et al, 2018) among researchers and policy makers. Although a number of IoT systems have been proposed for

use with smart buildings, on-grid solar systems with the capacity to collect data and alter the distribution of loads are a priority. Using smart devices to lower energy consumption is a key factor in the development of sustainable energy solutions, however, the feasibility of integrating these systems into the design of buildings has not yet been tested.

Research Methodology and Process

Figure 1. illustrates IoT devices used in sustainable energy system. The system under examination has been designed to include three major components including an on-grid solar system, a data collection capacity and an online control switch. The on-grid system comprises solar panels, an inverter, and the grid. A data collector sits between the solar panels and the inverter; and online switches are set up between the inverter and the grid. The system utilizes two energy sources to supply electricity and an inverter is used when electricity is required from the grid, or another AC source.

Figure 1. IoT devices used in sustainable energy system



To manage the system, a data collector is added to enable the online switch to control the inverter. Energy produced by the solar system may be used to supply electricity when there is radiation from the sun. This is combined with electricity from the grid if this is not sufficient for consumption. If surplus energy is produced by the solar system, it is transferred to the grid. The connection of this type of system needs to be approved by the electric authority and is limited to a maximum capacity of 40% of the total supply in Cambodia. However, in reality, electricity production and consumption are not always stable; with oversupply a common occurrence. It wastes money if it is not permitted to be supplied to the grid. There are several key points to be noted when designing such a system. First, an analysis of the load and the energy source needs to be conducted to size the system correctly. Second, the on-grids and load connections need to be controlled with an online switch to enable the system to operate.

Online functionality. Many functions have been developed for use on the internet. Data is received and used to control switches. This is applicable in many sectors and is designed to produce energy consumption data, as well as to control the switches. The data may be downloaded to an Excel file for further analysis.

Working example of a solar on-grid system. Photo-voltaic systems depend on both light intensity and the incident angle of the light. Good conditions occur when light intensity is high, with an incident angle that is perpendicular with the surface of panels. In Cambodia, the solar system may work for between 10 and 11 hours daily, however the production energy is not stable

over this time. The efficiency of systems using stand fixed panels and sun trackers is different.

The design of data collection. The collection of data from the photo-voltaic system are specific to the design of each system. To access this data, a voltage and current meters are required. This information is transferred via Bluetooth over short distances or via wireless for long distances.

Online Switch. Switches are used to turn the electricity on or off. There are several categories of switches that are commonly used including manual, remote and online types. Online switches may be controlled remotely by smart phone or computer. To enable this control, it is often required for these switches to be linked via both Wireless and Bluetooth.

Experimental Process. There were three main components used in the experiment including grid, data collection and online switch systems. The details of each component are provided in Appendix 1.

Prior to the experiment, a site selection process was a priority task to ensure sufficient light intensity would be achievable, with respect to sun light and a suitable temperature. For this experiment, the system was installed on the top of the Solar Green Energy Cambodia (SOGE) building. The Solar on grid system used in this experiment comprised two 65W solar panels connected in in parallel, a grid connected micro-inverter, a current and voltage meter and online switches (Figure 2).

The configuration of this system is shown in Figure 3. Two solar panels were installed and connected to an inverter to convert DC electricity into AC electricity, which was then combined with electricity from the grid to supply power to the building. During the daytime, when the solar panels could

produce sufficient power, it was supplied by solar panels. At other times, power was distributed from the grid. If the inverter was oversupplied, extra electricity was distributed to the grid automatically.

Figure 2. Configuration of the Proposed-On Grid System

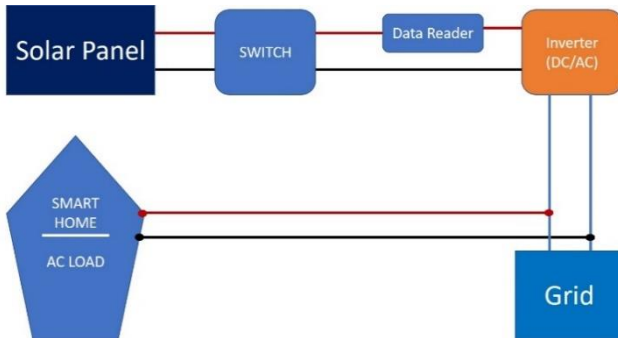
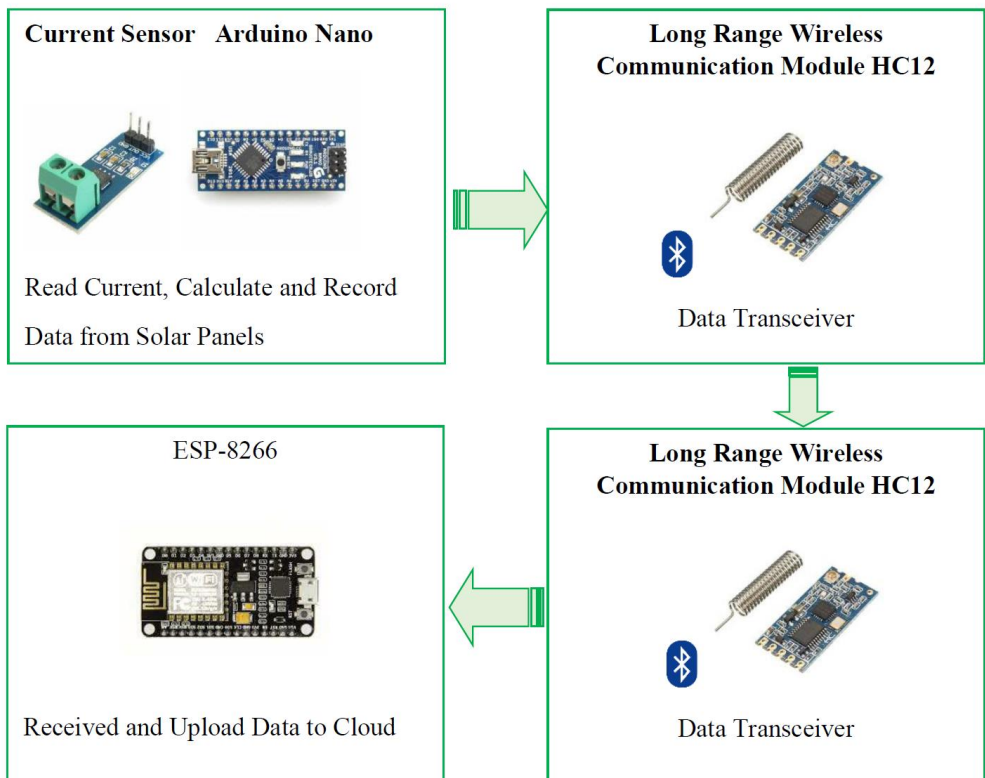


Figure 3. Configuration of the data reader or gateway and switch

Data Reader System



To record the amount of energy generated from the solar panels, a data reader system, or gateway, was used. The reader calculated and uploaded data to a web-based cloud, where the information was stored. It measured current, voltage and power generated from the solar panels before transferring this information via a long-range wireless communication module (HC-12 system and ESP-8266).

Results and Discussion

Electricity generated by the solar system

Table 2 displays the results for the electricity generated from the solar system. It was operated from 6:30 am till 5:00 pm. Energy production increased with light intensity as the injection angle of the light became more perpendicular to the surface of the panels. As the panels were fixed, the injection angle changed with the position of the sun. This meant that the energy produced varied over time. When radiation from the sun was perpendicular to the surface of the panel, light was at its highest and a maximum amount of energy was produced. An average electrical energy of 176.96 kWh per year was recorded from the data reader.

Table 2. Electrical energy generated from the 130 W solar system

Average output power (kW)	Average energy generated per day (kWh)
42.16×10^{-3}	484.84×10^{-3}
Average electricity from solar panels per year (kWh)	
176966.60×10^{-3}	

The data reader also recorded the average energy generated from one solar panel over various periods between 6:30 am and 5:00 pm, as shown in Table 3.

Table 3. Average electrical power and energy record by Data Reader

Average energy (kWh)	Time	Average power (kW)
55.41×10^{-3}	6:30 am - 9:00 am	15.83×10^{-3}
337.75×10^{-3}	9:00 am - 2:00 pm	67.55×10^{-3}
129.27×10^{-3}	2:00 pm - 5:00 pm	43.09×10^{-3}
	6:30 am – 5:00 pm	42.16×10^{-3}

Online switch control by smart phone

To control the switches remotely, a smart phone or laptop with internet access was required. This enabled it to be seen whether the load was switched on or off. These smart devices were able to control the switches remotely. The signal from the smart devices was transmitted to the gateway online and continued to the switch via a wireless connection. Using the HC-12 short range transmitter and receiver to send information to and from the gateway may help facilitating control in places where WIFI access is limited. They enable data to be sent over a distance of 30 meters.

The use of this experimental model produced knowledge about how this innovative system may help to solve energy issues related to both energy generation and the energy efficiency of buildings. This proposed system demonstrates how the control system, saves time and energy, reducing environmental impact. This experiment shows that an IoT device may be used to detect unusually high levels of energy consumption and manage them from

a distance. This model may help to observe and control electrical systems more effectively.

The environmental benefits of energy conservation

To generate electricity, most power plants burn coal, crude oil or other fossil fuels. Although this method of creating energy is relatively inexpensive, there are many environmental impacts. Carbon dioxide, sulfur dioxide and nitrogen oxides are just a few of the byproducts that result from these traditional methods of power generation. Reducing energy consumption reduces the amount of electricity that power plants have to produce, reducing the amount of fossil fuels that are combusted each day. If the experimental system is installed at scale, a large reduction in the volume of CO₂ emissions generated would result. This is a major cause of air pollution and global warming, which are major global environmental issues. It is expected that this system may play a role in addressing some of these issues in the near future.

Conclusion

An innovative system of efficiently integrating renewable energy sources with the grid in Cambodia was tested in terms of the economic and environment benefits it may provide. This was found to be an efficient, effective, and financially viable approach. This means that the proposed system may quickly achieve energy reduction targets by making buildings more energy efficient. The total cost of the control system is approximately 65 USD (current and voltage meters, three Arduino Nano systems, four HC-12, ESP-8266 and relay switches). This is affordable with a short payback period. It is recommended that people who live in the city that require large amounts of electricity to power their houses and buildings use this system to

reduce costs and energy consumption. The integration of renewable energy sources into existing grids is an effective approach to solve problems such as the poor energy efficiency, high costs, and limited function of existing systems. It may reduce the need to import energy from neighboring countries importing and reduce Cambodia's volume of CO₂ emissions, with immediate benefits for the country.

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Biography of Authors

Ty Bunly received BSc. in Physics from Royal University of Phnom Penh (RUPP) in 2016 and is currently pursuing his MSc. in Physics at the same institution. He has worked as solar system designer and installer for Solar Green Energy (Cambodia) since 2016.

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Appendix 1. Experimental specifications

Equipment	Quantity	Specification
<i>On grid system</i>		
Solar panel	2	<ul style="list-style-type: none"> • 65W
On grid inverter	1	<ul style="list-style-type: none"> • Grid-tied micro-inverter • Model: 3L2 • Input: 12-28VDC 20A MAX • Output: 180-260VAC 50Hz • Output power: 250 WP, 12V DC 230V AC
Grid	ECD	<ul style="list-style-type: none"> • Single phase
<i>Data collection</i>		
Voltage and current meter	1	<ul style="list-style-type: none"> • DC voltage meter • Max voltage: 30V • Current meter • Max current: 30A • HC-12, Arduino Nano
Gateway system	1	<ul style="list-style-type: none"> • HC-12, ESP 8266
Laptop	1	<ul style="list-style-type: none"> • Asus
Wireless network and cloud technology	1 set	<ul style="list-style-type: none"> • Cloud technology
<i>Online switch</i>		
Smart phone	1	<ul style="list-style-type: none"> • Redmi
Switch	2	<ul style="list-style-type: none"> • HC-12, Arduino Nano, Relay, MOSFET 1404

Using linear programming to optimize rice yields in Battambang, Cambodia

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សង្ខេប

កសិករកម្ពុជាបានអនុវត្តវិធីសាស្ត្របុរាណក្នុងការជ្រើសរើសទម្រង់ដាំដុះដំណាំស្រូវរាប់ជំនាន់មកហើយ។ ប៉ុន្តែគួរឱ្យស្តាយ ទម្រង់ដាំដុះបែបនេះផ្តល់ទិន្នផលទាប។ ដើម្បីទទួលបានទិន្នផលខ្ពស់បំផុត កសិករត្រូវចេះគ្រប់គ្រងផ្ទៃដីដាំដុះឱ្យបានត្រឹមត្រូវ។ វិធីសាស្ត្រកំណត់តម្លៃបរមាតែងត្រូវបានប្រើប្រាស់នៅពេលដែលមានធនធានស្តួចស្តើងដូចជាផ្ទៃដីដាំដុះ ដើមទុន កម្លាំងពលកម្ម ដី និងគ្រាប់ពូជជាដើម។ ការសិក្សានេះផ្តោតសំខាន់ទៅលើរបៀបបែងចែកផ្ទៃដីដាំដុះដើម្បីទទួលបានផលស្រូវអតិបរមា។ ចំណោទបរមារកទិន្នផលស្រូវត្រូវបានបង្កើតឡើងទាក់ទងនឹងស្រូវបីប្រភេទគឺ សែនក្រអូប ផ្ការំដួល និងស្រូវស IR504។ វិធីសាស្ត្រគណិតវិទ្យា Linear Programming ត្រូវបានប្រើប្រាស់ដើម្បីបង្កើតគំរូនិងរកចម្លើយអតិបរមា។ លទ្ធផលសិក្សាទៅលើផ្ទៃដីដាំដុះក្នុងតំបន់មួយនៃខេត្តបាត់ដំបង ដែលទទួលបានពីគំរូនេះបានបង្ហាញនូវលំនាំនៃការដាំដុះមួយដែលផ្តល់ទិន្នផលខ្ពស់បំផុតចំពោះស្រូវទាំងបីប្រភេទនេះ។ ការវិភាគបម្រែបម្រួលទិន្នផលស្រូវសរុបត្រូវបាន

អនុវត្តដោយធ្វើបម្រែបម្រួលទិន្នផលមធ្យមនៃប្រភេទស្រូវនីមួយៗក្នុងតំបន់ដាំដុះនោះ។ លទ្ធផលបង្ហាញថា អ្វីៗមានសភាពដូចគ្នា។ មានន័យថា បើទិន្នផលមធ្យមរបស់ស្រូវសែនក្រអូបប្រែប្រួល $\pm 10\%$ នោះទិន្នផលស្រូវសរុបនឹងផ្លាស់ប្តូរប្រហែល $\pm 7.68\%$ ដែរ។ ចំពោះស្រូវផ្ការំដួលក៏ដូចគ្នាដែរ។ បើទិន្នផលមធ្យមនៃស្រូវផ្ការំដួលប្រែប្រួលក្រោម 4101.65 Kg/Ha ទិន្នផលសរុបនៃប្រែប្រួលទេ។ ចំណែកទិន្នផលមធ្យមនៃស្រូវពីរប្រភេទទៀតមិនត្រូវបានផ្លាស់ប្តូរ។ ចំពោះស្រូវស IR504 ក៏ដូចគ្នាទាំងអស់ដែរ។ បើទិន្នផលមធ្យមប្រែប្រួលក្នុងកម្រិត $\pm 10\%$ ទិន្នផលមធ្យមនៃស្រូវពីរប្រភេទទៀតប្រែប្រួលក្នុងកម្រិត $\pm 2.24\%$ ។ លទ្ធផលនៃការសិក្សានេះនឹងផ្តល់ជំនួយដល់កសិករកម្ពុជាក្នុងការជ្រើសរើសទម្រង់ដាំដុះដែលផ្តល់ទិន្នផលខ្ពស់បំផុត។

Abstract

Cambodian farmers have been applying traditional techniques for selecting cropping patterns of rice production for generations. Unfortunately, current cropping patterns provide low yields. For the producing maximum rice yields, land resources need to be managed efficiently. Optimization techniques are often used for resource management when there is limited availability of land, capital, labor, and inputs; such as fertilizers and seeds. This study considers how to optimize the use of land resources to produce optimal rice yields. This problem was formulated for three varieties of rice: *sen kro ob* (fragrant rice), *phka romdoul* (premium fragrant rice), and *IR504* (white rice). A linear programming method was then used to model and determine an optimal solution. The results from this model demonstrate an ideal cropping pattern for the three varieties of rice aimed at achieving a maximum rice yield in the study area of Battambang. A sensitivity analysis was performed on these results by varying the average rice yield of each type of rice in the model. All things being equal, if the average yield of *sen kro ob* was changed by $\pm 10\%$, the optimal rice yield varied by $\pm 7.68\%$. Similarly, all things being equal, if the average rice yield of the *phka romdoul* was at any value below 4101.65 kg/ha, the optimal rice yield would be unchanged. Finally, all things being

equal, if the average yield of *IR504* was modified by $\pm 10\%$, the optimal rice yield would vary by $\pm 2.24\%$. These findings will assist Cambodian farmers to select cropping patterns that are more likely to achieve a maximum possible rice yield.

Keywords: rice, *sen kro ob*, *phka romdoul*, IR504, optimization, Cambodia

Introduction

Within Southeast Asia, Cambodia's economy is one of the most dependent on agricultural production. Rice is one of the most important crops and contributed roughly 17% of the country's GDP in 2014 (Goletti & Sin, 2016). Rice production and associated markets are estimated to provide jobs for around three million Cambodian citizens (MAFF, 2017). Rice is still a staple food for many in the country and it is a crop that is still highly significant in contributing to food security, political security, as well as national socio-economic development when surplus production is exported. Cambodia has realized a remarkable increase in rice exports over the past decade. For instance the country formally exported 100,000 metric tons of milled rice in 2010; 378,000 metric tons in 2013; 542,144 metric tons in 2016; and in average 600,000 metric tons annually between 2016 and 2018 (CRF, 2020).

As a lower middle income economy, Cambodia previously enjoyed duty-free exports to EU markets under the Everything-But-Arms (EBA) trade scheme, up until 2019. Under this scheme, the around 48% of Cambodia's total rice surplus was exported to the EU 2012 and 2018 (MAFF, 2017). However, these exports fell sharply in 2019, following the imposition of tariffs. Six months after the introduction of these tariffs, rice exports to the EU were reduced by 32%, compared to the same period of the previous year

(93,503 metric tons) (SOWS-REF, 2019). This adversely affected almost 500,000 families in Cambodia, who were highly dependent on rice production for their livelihood (CRF, 2020). In January 2020, rice exports to the EU decreased by a further 15%, or 22% compared to the same period in 2019. This reduced the total revenue from rice exports in January 2020 in Cambodia to only \$39 million. The country is predicted to lose about 50 million USD per annum, as a result EU tariffs (CRF, 2020).

The land area that rice was cultivated on in Cambodia was estimated to be 3.052 million hectares in 2016, accounting for 74% of the total land area under cultivation (MAFF, 2017). An average yield of 3.117 tons per hectare means that the country produces a total volume of around 9.29 million tons of rice per annum. While a significant proportion of this is used for to meet domestic needs, there is a surplus of around 4.7 million tons (3 million tons of good rice) per annum that is exported to international markets (MAFF, 2017).

In 2010, the Cambodian government pledged to increase rice production in line with an export target of one million tons per year by 2015. However, this target is yet to be reached, with exports in 2018 amounting to just 626,225 metric tons (OCM, 2019). The failure to achieve this target has been a result of inconsistent paddy quality and poor post-harvest management (CRF, 2020). Many farmers still adopt traditional techniques that have been passed down over generations (Srean et al., 2018). While these techniques may be enhanced with access to high-tech farming practices, investment in research and development for rice production is still limited (CRF, 2020). One challenge that exists for many farmers is not having

the capacity to determine optimal cropping patterns to maximize rice yields. Additionally, the quality of rice produced in Cambodia is often not in line with international standards, which results in lower prices being achieved in the market place.

Effective land management practices, including an improved capacity to select optimal cropping patterns for rice production (Shreedhar, 2018), may be a solution to increasing rice yields under these current constraints. To date, there has been no research conducted on the use of linear programming methods to optimize the rice yields in Cambodia. In this study, an optimization model has been developed to determine the most effective cropping patterns for maximizing the combined yield of three specific rice varieties. This problem was formulated previously using linear programming to determine cropping patterns that would produce optimal yields for multiple crops (Shreedhar, 2018).

The study places extra constraints on some resources in this model to determine an optimal pattern for maximizing the net benefits of rice production in Battambang, Cambodia. It builds on the use of linear programming to improve the management of land and water resources in Egypt through the use of optimal cropping patterns (Osama et al., 2017). The model was first tested on a hypothesized area of 1,000 ha using actual data collected from Battambang, which may later be extended to larger areas of Cambodia. Due to time restrictions, the study only focused on three rice varieties: *sen kro ob*, *phka romdoul*, and *IR504*. The linear programming method was used specifically for: (1) optimizing rice yields in the Battambang

with respect to gross income and production inputs; and (2) conducting a sensitivity analysis.

Research Methodology

Battambang, a province in the far northwest of the Cambodia, is the focus of this study. It borders Banteay Meanchey province to the north, Pursat to the south, Siem Reap to the northeast, and Pailin to the west. The Tonle Sap also forms part of northeastern boundary of Battambang between Siem Reap and Pursat. It is the fifth most populous province in Cambodia, accounting for 6.5% of the total population of the country (15,288,489 in 2019). Battambang also comprises the fifth largest land area of all Cambodian provinces (MoP, 2019). Fertile rice fields and an economy based predominantly on agriculture have led to the bestowal of the moniker ‘the rice bowl of Cambodia’.

This study assumes a hypothetical land area of 1,000 ha using actual data for three varieties of rice (*sen kro ob*, *phka romdoul*, and *IR504*) for analysis, provided by Amru Rice Cambodia (SRP, 2018). A linear programming method has been used to determine an optimal cropping pattern for the three varieties in terms of a maximum rice yield. The objective function of the related model is subject to the following constraints: (1) the land area requirement for the crop, (2) fertilizer requirements, (3) seed requirements, (4) labor requirements, and (5) minimum profit. The optimization problem was formulated as follows:

Objective function of the maximum rice yield:

$$Z = \sum_{i=0}^2 RY_i \times x_i$$

Where: RY_i = the rice yield per Ha of i^{th} variety in Kg/Ha, and x_i is the area of i^{th} variety in the study in Ha (the decision variables).

Constraints on land use:

$$x_0 + x_1 + x_2 \leq ALA, \quad (1)$$

Where x_i is the area of i^{th} variety in the study in ha, and ALA is the available land area in ha.

Constraints on fertilizer use:

$$\sum_{i=0}^2 F_i \times x_i \leq AF, \quad (2)$$

Where F_i is the amount of fertilizer used per ha of i^{th} variety in kg/ha, and AF is the available amount of fertilizer in kg.

Constraints on seed use:

$$\sum_{i=0}^2 S_i \times x_i \leq AS, \quad (3)$$

Where S_i is the amount of seed used per ha of i^{th} variety in kg/ha, and AS is the available amount of seed in kg.

Constraints on profits:

$$\frac{\sum_{i=0}^2 (CI_i - E_i)x_i}{\sum_{i=0}^2 x_i} \geq \text{MinPro}, \quad (4)$$

Where CI_i is the gross income of rice yield per ha of i^{th} variety in USD, E_i is the total production cost of i^{th} variety per ha in USD, and MinPro is the

minimum average profit per ha in USD for cultivation of the three rice varieties.

Constraints on human labor force (HLF)

$$\sum_{i=0}^2 LF_i \times x_i \leq AT, \quad (5)$$

Where LF_i is the labor force spent per ha of i^{th} variety in day, and AT is the available labor force per ha in day.

Findings and Discussion

Rice yield, gross income and expenditure on inputs

For a solution to be obtained using the linear programming method, the associated parameters in the related model must be realized numerically. The values of the parameters given in Table 1 and Table 2 were used in this case. Each value is an average of the corresponding data collected by Amru Rice in 2018, across Battambang province (SRP, 2018). For instance, the value of 4596.88 kg/ha given in Table 1 is the mean value for the yield of *sen kro ob* rice calculated on the basis of data collected for all rice cultivated in the province in 2018 (SRP, 2018).

Similarly, in Table 2, the value 258.59 kg/ha refers to the average amount of fertilizer used for cultivating *sen kro ob* rice; while the value 247,166 in the last row refers to the total amount of the fertilizer available for cultivation of all three varieties over the entire 1,000 ha. To obtain an optimal cropping pattern for the three varieties, the linear programming model was run

using the Python code provided in the Appendix (Pine, 2019). The numerical results from this model are given in Table 3.

Table 1. Rice yield, gross-income (for fresh rice sold to Amru Rice) and input expense data used in the study

Attributes	Rice Yield (Kg/ha)	Cross-Income (USD)	Expense (USD)
Sen Kro Ob	4596.88	1263.9	426
Phka	2891.43	888.98	383
Romdoul			
IR504	5409.38	1148.4	511

Source: Amru Rice Cambodia, 2018

Table 2. Actual constraint data obtained for 2018

Constraints	Area (Ha)	Fertilizer (kg/ha)	Seed (kg/ha)	Profit (USD/ha)	Labour force (days/ha)
Sen Kro Ob	x_0	258.59	150.84	-37.9	72
Phka	x_1	180.57	127.97	294.02	59
Romdoul					
IR504	x_2	302.34	298.75	162.6	86
Limitation	1000	247166	192520	800	70000

Source: Amru Rice Cambodia (2018)

Decision variables are displayed in the first column, while optimal values are displayed in the second column. Specifically, the optimal cultivation area for *sen kro ob*, *phka romdoul*, and *IR504* varieties was calculated to be 751.124 ha, 0 ha, and 175.077 ha, respectively, to obtain a maximum rice yield for the hypothetical 1,000 ha land area. This includes an uncultivated land area of 73.799 ha.

This cropping pattern is estimated to lead to an optimal rice yield of 4,494,592.11 kg. However, as some parameters have a level of uncertainty

due to factors such as climate change, insect damage, and water availability; a sensitivity analysis needs to be conducted. The results of varying the land cultivated of each type of rice is presented in the next section.

Table 3. Numerical results generated in Python

Decision	Optimal solution (ha)	Objective coefficients	Lower limit of objective coefficients	Upper limit of objective coefficients
x_0	751.124	4596.88	-1386.94	5089.28
x_1	0	2891.43	-infinity	4101.65
x_2	175.077	5950.32	5374.61	Infinity

Sensitivity analysis of rice yields

A sensitivity analysis was conducted by solving the model for a decreased and increased average yield of *sen kro ob* rice by 10%, with results displayed in the first and third columns of Figure 1, respectively. All other variables were kept constant. The bar chart shows that when the average yield of *sen kro ob* is decreased by 10%, the total optimal rice yield also decreases to 4,149,309.54 kg, a reduction of 7.68%. Conversely, if the yield is increased by 10%, the optimal yield rises 7.78% to 4,833,178.72 kg.

Similarly, all things being equal, the bar chart in Figure 2 displays the results for total maximum rice yield when a 10% decrease and increase is applied to the average rice yield for *phka romdoul*. The optimal rice yield is shown to remain the same in both cases. In fact, the average yield of *phka romdoul* may take any value less than 4101.65 kg and the total yield would still remain constant.

Figure 1. Optimal rice yield when varying the yield of the *sen kro ob*

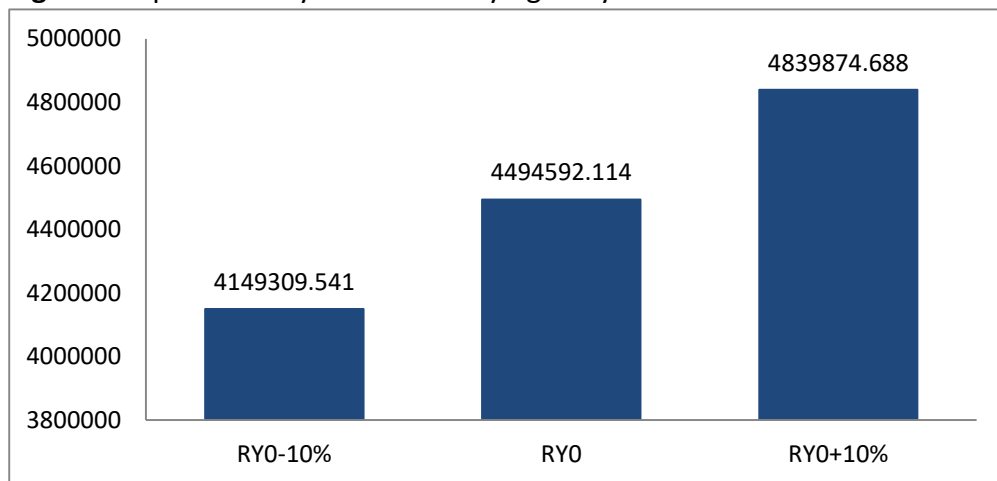
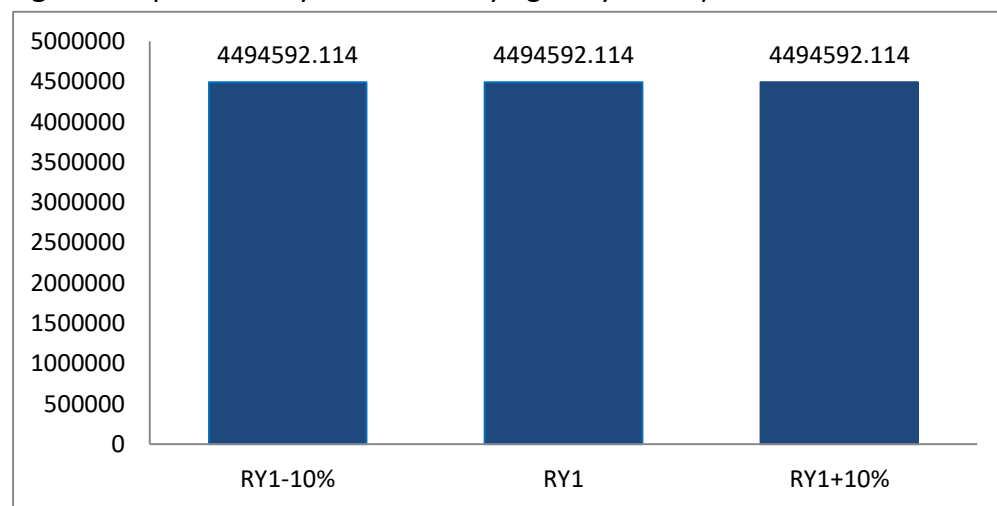
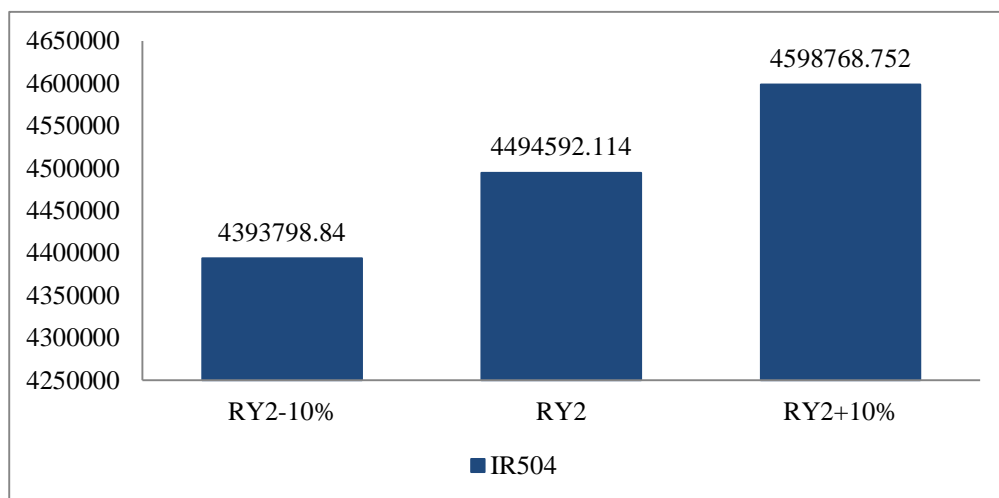


Figure 2. Optimal rice yield when varying the yield of *phka romdoul*



Finally, all things being equal, if the average yield of *IR504* is decreased or increased by 10%, the optimal rice yield will vary according to the results outlined in the bar chart in Figure 3. It shows that when the average yield of *IR504* is decreased by 10%, the optimal rice yield decreases by 2.24%. Conversely, if the amount is increased by 10%, the optimal rice increased by 2.31%.

Figure 3. Optimal rice yield when varying the yield of IR504



Conclusion

In this study, a linear programming method has been used to solve optimization problem and determine an ideal cropping pattern for obtaining a maximum rice yield using a combination of three rice varieties: *sen kro ob*, *phka romdoul*, and *IR504*. This cropping pattern was determined using actual data collected from Amru Rice, Cambodia in Battambang (SRP, 2018). A hypothetical land area of 1,000 ha was assumed in the model. Different constraints were imposed for the study, including a maximum land area for cultivation, fertilizer use, seed use, the availability of labor, and a minimum profit per ha. The optimal cropping pattern for *sen kro ob*, *phka romdoul*, and *IR504* rice varieties was determined to be 751.124 ha, 0 Ha and 175.077 ha, respectively. This pattern is predicted to result in an optimal yield of 4,494,592.114 kg.

A sensitivity analysis showed that all things being equal, when the average yield of *sen kro ob* was decreased or increased by 10%, the optimal

rice yield would vary by up to 7.68%. The same variation in the average yield of *phka romdoul* resulted in no change to the optimal rice yield. The same outcome would occur for any average rice yield for *phka romdoul* below 4101.65 kg/ha. Finally, the same variation in the average yield of *IR504* results in a variation in the optimal rice yield of 2.24%. The result of this study will be distributed among Cambodian farmers to assist with decisions about cropping patterns to maximize potential rice yields. The methodology used for this study may be extended to crops other than rice, as well to other parts of Cambodia. The decision variables may be also be changed to represent different growing conditions.

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Brief Biography

Dr. VENG Sotheara Veng is a lecturer and researcher in the Graduate School of Science at the Royal University of Phnom Penh (RUPP), where he has been since 2019. He received a Bachelor and Master Degree in Mathematics from the Royal University of Phnom Penh. He also holds an MSc in Applied Mathematics from the University of the Philippines and a PhD in Mathematics from the Pusan National University in South Korea. His research interests is financial mathematics including option pricing and portfolio optimization problems. He published several papers in international journals.

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Appendix. The formulated LP optimization problem is solved using Python code running in Spider 4.0.1

```
1  from pymprog import *
2  c = (4596.88 , 2891.43, 5950.318) # coefficient of objective function
3  A = [(1, 1, 1), (258.59, 180.57, 302.34), (150.84, 127.97, 298.75), (-37.9, 294.02, 162.6)
4  (72, 59, 86)] # coefficient of 3 variables
5  b = (1000, 247166, 192520, 0, 70000) # value of constraints
6  begin('basic')
7  verbose(True)
8  x = var('x', 3) #create 3 variables
9  maximize(sum(c[i]*x[i] for i in range(3)))
10 for i in range(5):
11     sum(A[i][j]*x[j] for j in range(3)) <= b[i]
12 solve() # solve the model
13 print("###>Objective value: %f"%vobj())
14 sensitivity() # sensitivity report
15 end() #the end of the code
16
```


Seasonal poverty in Zimbabwe and Cambodia: A comparative analysis of the developing world

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សង្ខេប

គេបានលើកឡើងថា ធម្មជាតិនៃភាពក្រីក្រតាមរដូវកាលគឺកើតមានតាមបរិបទជាក់លាក់។ ប៉ុន្តែ ការអះអាងនេះកម្រមានការបកស្រាយឬភ័ស្តុតាងបញ្ជាក់ណាស់។ ការសិក្សានេះបញ្ជាក់ថា តើធម្មជាតិនៃភាពក្រីក្រតាមរដូវកាលពិតជាប្រែប្រួលតាមបរិបទមែនឬទេ? ការសិក្សានេះបានប្រៀបធៀបធម្មជាតិនៃភាពក្រីក្រតាមរដូវកាលក្នុងប្រទេសហ្ស៊ីមបាវ៉េនិងប្រទេសកម្ពុជា។ ការសិក្សានេះបានប្រើវិធីសាស្ត្រស្រាវជ្រាវបែបរុករក ដោយប្រើប្រាស់ទិន្នន័យដែលមានស្រាប់ និងទិន្នន័យបឋមមួយចំនួនរួមបញ្ចូលគ្នា។ លទ្ធផលបង្ហាញថា (1) ទាំងកម្ពុជា និងហ្ស៊ីមបាវ៉េ ធ្លាប់ជួបប្រទះស្ថានភាពពិតជាក់ស្តែងតាមរដូវដែលពាក់ព័ន្ធនឹងមិនពាក់ព័ន្ធនឹងអាកាសធាតុ។ ប៉ុន្តែទោះជាយ៉ាងនេះក្តី ស្ថានភាពបែបនេះមួយចំនួនជារឿងចម្លែកចំពោះប្រទេសកម្ពុជា។ (2) ភាពស្មុគស្មាញនៃភាពក្រីក្រតាមរដូវកាលទាំងនៅកម្ពុជានិងហ្ស៊ីមបាវ៉េគឺមានលក្ខណៈដូចគ្នា។ (3) នៅក្នុងប្រទេសទាំងពីរ ភាពក្រីក្រច្រើនកើតឡើងនៅរដូវវស្សា។ ដូច្នេះ ទោះបីកម្ពុជានិងហ្ស៊ីមបាវ៉េស្ថិតក្នុងបរិបទខុសគ្នាក៏ដោយចុះ តិចឬច្រើន ភាពក្រីក្រតាមរដូវកាលមានលក្ខណៈស្រដៀងគ្នា។ ដូច្នេះ ការសិក្សានេះបញ្ជាក់ថា ការលើកឡើងថាភាពក្រីក្រតាមរដូវកាលកើតមានតាមបរិបទគឺមិនត្រឹមត្រូវទាំងស្រុងនោះទេ។ ដោយសារភាពក្រីក្រតាមរដូវកាលជារឿងជៀសមិនផុត ការសិក្សានេះផ្តល់អនុសាសន៍ថា ប្រទេសហ្ស៊ីមបាវ៉េ កម្ពុជា និងប្រទេសកំពុងអភិវឌ្ឍ

ដំទៃទៀតគួរដាក់បញ្ចូលវិសាលភាពនៃភាពក្រីក្រតាមរដូវកាលទៅក្នុងគោលនយោបាយ កាត់បន្ថយភាពក្រីក្រ ដើម្បីកាត់បន្ថយជាអតិបរមានូវឥទ្ធិពលនៃភាពក្រីក្រតាមរដូវកាល មកលើជីវភាពរស់នៅរបស់ប្រជាពលរដ្ឋក្រីក្រ និងដើម្បីលើកកម្ពស់សមត្ថភាព ជនក្រីក្រក្នុងការទប់ទល់នឹងបញ្ហាផ្សេងៗដែលកើតឡើងតាមរដូវកាល។

Abstract

It has been claimed that the nature of seasonal poverty is context-specific, but this claim is rarely substantiated. This study therefore ascertains whether the nature of seasonal poverty varies according to context. It examines this supposition by comparing the nature of seasonal poverty in both Zimbabwe and Cambodia. The study employed an exploratory methodology. It predominantly made use of secondary data, along with limited primary data. The results show that: (1) Both Zimbabwe and Cambodia experience climatic and non-climatic seasonal realities, however, some of these are peculiar to Cambodia. (2) The complexity of seasonal poverty in Zimbabwe and Cambodia is similar. (3) In both countries, seasonal poverty is more pronounced in the wet season. Thus, despite the remarkable contextual disparities between Zimbabwe and Cambodia, the nature of seasonal poverty in each country is, by and large, similar. Thus, the claim that seasonal poverty is context-specific is considered to be inaccurate. Since seasonal poverty is inevitable, the study recommends that Zimbabwe, Cambodia and other developing countries should factor the impact of this seasonal dimension into poverty reduction policies. The focus should be on minimizing the effects of seasonal poverty on the livelihoods of the poor and enhancing their resilience to seasonality.

Keywords: seasonal poverty, seasonality, Zimbabwe, Cambodia

Introduction

Seasonal poverty entails realities⁴ that people, especially the poor, experience repeatedly at certain times of the year brought about by marked

⁴ Realities refer to undesirable life or poverty conditions (Chambers, 2012; Gweshengwe, 2020)

changes of climatic and non-climatic seasons (Gweshengwe, 2020). It is multidimensional: manifests in financial, economic, material, social and environmental aspects of poverty (Chambers, 2012). Many scholarly studies have been conducted on the nature and effects of seasonal poverty (Chambers et al., 1981; Devereux et al., 2008, 2012; Devereux & Longhurst, 2009), as well as the significance of understanding seasonal poverty (Chambers, 1979, 1982, 2012). The studies claim that the nature of seasonal poverty varies by context (Devereux et al, 2012). However, little, if any, effort has been made to validate this claim. Does that mean that the nature of seasonal poverty is different from country to country? Motivated by this question, the current study offers a comparative analysis of the nature of seasonal poverty in Zimbabwe and Cambodia. These two countries have different geographical, economic, social, political and environmental contexts. This contrast poses the question of whether it is relevant to compare seasonal poverty in each case, as the countries do not appear to be comparable. This has influenced the choice for Zimbabwe and Cambodia for this study. The salient contextual disparities of each country are considered to enrich the analysis.

Seasonal poverty was first defined in the 1970s in a seminar at the Institute of Development Studies at the University of Sussex, and two seasonal poverty conferences were held in 1978 and 2009 (Chambers, 1981; Devereux et al., 2012). It becomes topical as it manifests in financial, economic, material, social and environmental dimensions of poverty and has an enormous effect on the livelihoods of people with limited means or opportunities (Chambers & Longhurst, 1981; Gweshengwe, 2020).

It emanates from both climatic and non-climatic seasonality (Devereux et al., 2012). Climatic seasonality, the change from wet to dry seasons and vice versa, triggers seasonal variations in production, labour requirements or employment opportunities, commodity prices, health, malnutrition and mortality (Devereux 1993, Devereux et al., 2008; Chambers 1979). It brings about or to peak realities, such as food shortages, high food prices, lack of money, indebtedness, diseases (such as malaria, diarrhea and skin infections), snakebites and weak social capital (Chambers & Longhurst, 1981; Devereux et al., 2012). Non-climatic seasonality refers to cyclical educational, social, religious, political and economic events, such as returning to school, festivals or religious celebrations, elections, and production cycles (Gweshengwe, 2020). These cyclical events are associated with realities, such as depressions, price hikes, financial stresses, debts, losses of household assets, and neglect (Chambers, 2012; Hadley, 2012; Lokshin & Radyakin, 2012).

Seasonal poverty has three main effects. First, it constrains livelihoods (Devereux et al., 2012). To cope with seasonal poverty, the poor often adopt desperate and irreversible measures, which include seasonal migration under distress, selling assets, eating less, and borrowing money and food at high-interest rates (Chambers, 1982; Sabates-Wheeler & Devereux, 2012). According to Chambers (1981), household assets are sold at a low price, without hope for recovery. These coping measures tend to adversely impact people's livelihoods. Second, it disempowers poor members of a community (Devereux, 1993). It subordinates the poor to the non-poor. Seasonal hunger and a lack of money compel the poor to accept low wages for their labour, as well as loans with higher interest rates as they are in a weakened position to

negotiate for better conditions (Chambers, 1981; Devereux, 1993). Consequently, non-poor members of a community tend to pass down seasonal stresses to the poor (Devereux et al., 2012). Third, it usually results in poverty traps that have adverse effects on livelihoods, and disempower the poor (Sabates-Wheeler & Devereux, 2012).

Seasonal poverty is a common phenomenon in developing countries. In The Gambia, for example, the wet season is associated with food shortages, a high incidence of infections, lower body weights of mothers, lower birth weights, and high child morbidity and mortality (Chambers 1979). In the Zaria region of Northern Nigeria, there is a distinct wet-season peak in malaria, measles, diarrhea and guinea worm. This coincides with the time of highest labour demand (Chambers, 1979). The wet season in Malawi is associated with food shortages and high food prices (Chirwa et al., 2012).

In Bangladesh, climate-induced seasonal poverty is characterized by seasonal hunger (Monga), limited work opportunities, water-borne infections (diarrheal disease) and problems with livestock diseases, among other realities (Conroy & Vignon, 2012). Rural communities in Lao People's Democratic Republic are more vulnerable to snakebites during the rainy season, between May and October (Vongphoumy et al, 2015). Moreover, seasonal hunger is common and usually occurs in March before the harvest of irrigated rice and mid-August through the end of October (World Food Programme, 2013). Prices of food items are beyond the reach of many poor people in the country the rural poor tend to depend on mushrooms and bamboo sprouts from forests during this time (World Food Programme,

2013). In Thailand, the rainy season is associated with a high incidence of diarrheal disease (McCormick et al., 2012).

According to Basu and Wong (2015), the poor in West Timor, one of Indonesia's poorest provinces, experience *musim paceklik* (seasonal hunger) from November to February. During this period, food prices are high and often the poor are required to borrow against future harvests (Basu & Wong, 2015). Lastly, in Brunei Darussalam, seasonal poverty is characterized by back to school and rainy season realities (Gweshengwe, 2020).

The study aims to ascertain whether the nature of seasonal poverty varies according to context. To this end, it examines, first, the characteristics of seasonal poverty in Zimbabwe and Cambodia; and then analyses if the characteristics vary between the countries. It advances knowledge on seasonal poverty as it tests the assertion that seasonal poverty is context-specific. This study is unique because it compares seasonal poverty between countries that are contextually very different, and challenges the conventional understanding that seasonal poverty varies according to context.

Research Methodology

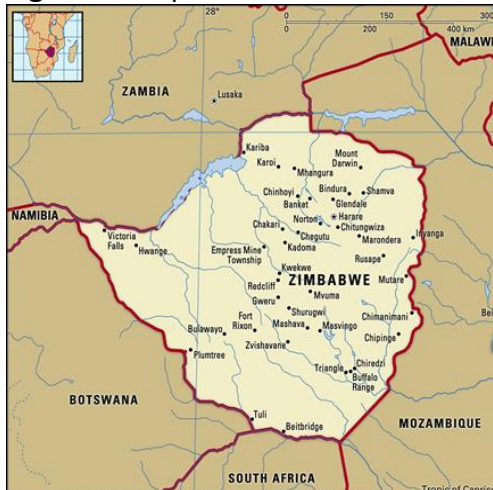
The study adopted an exploratory research method, which according to Gratton and Jones (2010), focuses on generating invaluable insights about a phenomenon with little or no available prior knowledge. The exploratory method was appropriate as little, if any, literature exists about how seasonal poverty varies according to context. It is also a flexible approach that enables different features of a phenomenon to be considered as they emerge (McNabb, 2010). Data were collected predominantly from secondary sources,

such as government and NGO reports, newspaper articles, and published scholarly material on the nature (dimensions, causes and effects) of seasonal poverty, using document analysis. The study also used primary data collected using unstructured interviews and observations. Unstructured interviews were conducted with two key informants from Cambodia, selected purposively on the basis of their in-depth understanding of Cambodia's education system and way of life. Observations were used to collect data on seasonal poverty in Zimbabwe (Figure 1 and Figure 2). The study used thematic analysis to induce knowledge about the nature, effects and period of seasonal poverty from the data. The data collected from Zimbabwe and Cambodia were not specific to particular provinces as the aim was to provide only a general picture of seasonal poverty for comparison. The countries were selected because of their contextual differences highlighted in the background section of this paper.

Zimbabwe is a landlocked country in the southern region of Africa. It has a total population of 13,572,560, comprising 6,514,829 males and 7,057,731 females (Zimbabwe National Statistics Agency, 2019). Shona and Ndebele are the main ethnic groups in the country. Politically, it is ruled by a democratically elected president, with an economy anchored on agriculture and mining. Zimbabwe, in 2018, had a GDP per capita of around 2,146 USD (World Bank, 2018). In 2017, 70.5% of the population was living in poverty (Zimbabwe National Statistics Agency, 2019). Poverty in the country is a result of factors such as a lack of employment opportunities, poor wages, inconsistent monetary policy, natural disasters, and weak social capital (personal communication, April 30, 2020). Climatically, Zimbabwe has marked

wet and dry seasons; with the wet season runs from October to April and the dry season from May to September.

Figure 1. Map of Zimbabwe



Source: Sanger et al. (2020)

Figure 2. Map of Cambodia



Source: Overton and Chandler (2019)

Cambodia is located in Southeast Asia, and according to National Institute of Statistics (2018), it has an estimated total population of 15.8 million, comprising 7.7 million males and 8.0 million females. Khmer is the main ethnic group and the economy is mainly supported by the garment industry, tourism, construction, agriculture and fishing (Officer, Ministry of Tourism, personal communication, March 8, 2020). In 2018, the GDP per capita was 1,520 USD (World Bank, 2018), with about 12.9% of the population living below the national poverty line (ADB, 2020). According to Culas and Tek (2016), the poorest people in Cambodia are isolated and usually live in remote villages with limited access to basic social services and facilities. Widows, orphans, street children and people with disabilities are among the most vulnerable groups in the country; they have limited access to education, training and employment opportunities (Naron, 2012). Cambodia has a

monsoonal climate, with a distinct wet and dry season. The wet season usually runs from May to November and the dry season from December to April (UNESCAP, 2002).

Results and Findings

The characteristics of seasonal poverty in Zimbabwe

Seasonal poverty in Zimbabwe is characterized by both climatic and non-climatic realities (Table 1).

Table 1. Characteristic of seasonal poverty in Zimbabwe

Climatic realities	Non-climatic realities
Seasonal hunger	Back-to-school stresses
Human and cattle diseases	Festivals
Shortage of money	Seasonal economic stresses
Debts	
Powerlessness	
Uncomfortable housing	
Transport challenges	
Weak social capital	
Snakebites	

Climatic realities are more pronounced in the wet season (October to April) and less in the dry season. Non-climatic realities emanate from the school calendar, festivals and the production cycle. Seasonal hunger occurs from January to March. For instance, in 2013, about 1.6 million people required food assistance during this time (UNOCHA, 2013). In 2019, approximately 8 million were considered to be food insecure during the peak of this hungry season (Chingono, 2020).

Seasonal hunger in Zimbabwe is more extreme in rural areas, where people depend on farming for food (Chingono, 2020). During the wet season, the poor usually exhaust their food reserves and food prices peak beyond their reach as demand exceeds supply (personal communication, December 28, 2019). To cope with seasonal hunger, the poor reduce quantity and number of meals each day, eating less nutritious meals. This occurs at a time of the year when immune systems are also challenged by seasonal infections and increased agricultural work requirements (personal communication, December 28, 2019). Labour during this time is poorly remunerated and is hired out at the expense of own production, trapping the poor in poverty. Also, the poor sell their productive assets, especially livestock, to purchase food (personal communication, December 28, 2019).

The wet season in Zimbabwe tends to coincide with a high incidence of human diseases, such as malaria and diarrhea (Gunda et al., 2017; Simango & Mbewe, 2000; Tshuma, 2019; Tunhira, 2012). The malaria season runs from mid-February to May (Ruzvidzo, 2017). In February 2013, for example, over 20,000 malaria cases were recorded in the country (The Herald, 2013a) and in Manicaland Province, malaria claimed 10 lives in one week (Chipunza, 2013). Diarrheal diseases, such as cholera, typhoid fever and dysentery, peak during the wet season (Simango & Mbewe, 2000). According to Manangazira (2017), in January 2017, 52 people died of diarrhea, and 39,766 cases of the disease were recorded countrywide. The incidence of diarrhea is higher in rural areas, where the practice open defecation is rampant during the wet season caused by the collapse of latrines due to excessive rains (personal communication, January 14, 2020; Tshuma, 2018).

Cattle, which are essential for rural livelihoods, are vulnerable to lumpy skin and theileriosis diseases during the wet season. For instance, in February 2013, at 1 112 lump skin disease cases were recorded in just a week in Mashonaland West province (The Herald, 2013b). In 2018, 50,000 cattle were lost to theileriosis, which is known locally known as 'January disease' and affects both commercial and subsistence farmers (Munjenjema, 2019). Thus, these seasonal livestock diseases threaten rural livelihoods.

The rainy season in Zimbabwe is associated with a lack of money and increasing debt. For the most part, the rural and urban poor depend on outdoor livelihood activities, such as vending, hand quarrying, brick molding and *maricho* (piece work) (personal communication, February 7, 2020). These livelihood activities rarely generate sufficient income and are affected by the rain. This compels the poor to borrow money at high-interest rates to meet household expenses, such as food, rent, utilities, and school fees. In some parts of Chipinge Rural District, the poor experience acute shortage of money between December and February, it is common for them to fall into debt (personal communication, February 7, 2020).

The wet season in Zimbabwe tends to disempower the poor: their bargaining power to negotiate for fair prices for goods and services is weakened as they become more desperate for food, health services and other essentials (personal communication, February 7, 2020). Moreover, during the wet season, they are usually not in a position to bargain for fair wages due to urgent need of money and a labour surplus. Non-poor people take advantage of this situation and exploit the poor.

Uncomfortable housing is another reality associated with the wet season in Zimbabwe (personal communication, December 29, 2019). In rural areas, houses of the poor are usually built of mud or farm bricks, with grass-thatched rooves. In urban areas, rooves for some poor families are either poorly corrugated or crudely 'thatched' with plastic. Hence, leaking and collapsing rooves as well as dampness in houses are common.

The rainy season is also a challenging time for public transport users in Zimbabwe. Public transport or *kombi* operators tend to charge exorbitant fares from town to residential areas when it rains. One operator was quoted as saying: *"We want to maximize on these rains so that we cash on time. Also, our trips would be few due to rains as traffic of people travelling will be low"* (Chirisa, 2019). For instance, in November 2019, fares from the Harare Central Business District to Chitungwiza and Ruwa increased from 10 to 15 ZWD, while to Glenview, Kuwadzana and Hatcliff, the fare increased from 5 to 8 ZWD (Chirisa, 2019). These fare hikes shift the burden of the wet seasons onto the poor, who are already experiencing other wet season realities such as a shortage of money and food.

Social networks, which are a form of social capital and essential for livelihoods (Tenzin et al., 2015; Yanlong Zhanga et al., 2017), are also generally weak during the rainy season in Zimbabwe (personal communication, December 29; 2020). Family visits strengthens social networks. However, families rarely visit each other during the rainy season due to high transport costs, a lack of money and food, and unpleasant home environments (personal communication, December 29; 2020). Rural people are most

affected: their urban relatives usually wait until the end of the rainy season to visit them.

Snakebites are also a common wet-season reality in the country (Mupangi, 2014). Four species of venomous snakes: colubrids (boomslang), vipers (puff adder), elapids (mambas and cobras) and atractaspids (bibron stilleto snakes) are active between November and April, and is when snakebites are at the peak (Muguti et al., 1994; Nhachi & Kasilo, 1994; Tagwireyi & Ball, 2011). As there is a shortage of anti-venom in Zimbabwe; bites from poisonous snakes have the potential to lead to instant death (Moyo, 2018; Mupangi, 2014). At the beginning of 2018, around 320 snake bites were recorded in the country (Moyo, 2018). In rural areas, women are more vulnerable to snakebites as they work in fields and fetch water and firewood; however, in urban areas, men are more prone to snakebites as they engage more in outdoor livelihood activities (Tagwireyi and Ball, 2011).

Winter in Zimbabwe, which runs from May to July, is also a difficult time for the poor (personal communication, February 7, 2020). When the weather is cold, prices for blankets and winter wear extend beyond the reach of poor and some go without warmth and experience health problems, such as colds and flu.

Back-to-school stresses, non-climatic realities, are also common in Zimbabwe and are brought about by the schooling calendar (personal communication, February 7, 2020). Primary and secondary schools have three terms in a year. The first term runs from early January to March, the second from May to early August and third from September to early December. The beginning of the first term is the most stressful for families. Learners starting

new grades or levels need new uniforms and stationery in addition to school fees and, for some, bus fares. Poor families struggle to raise money for these expenses (personal communication, February 7, 2020). Prices for school materials and uniforms usually go up during the back-to-school season due to increased demand, causing many families, come out of Christmas and New Year celebrations broke, greater stress. This pushes some families into debt as they borrow money, usually from illegal money lenders (loan sharks), to meet schooling expenses (Zijena, 2015).

Festival stresses are another non-climatic seasonal realities experienced in Zimbabwe. The most common ones are those associated with Christmas and New Year celebrations, which are of both religious and social significance (personal communication, February 7, 2020). Sufficient money is required for special meals, clothes and gifts as well as groceries and transport for visiting parents and extended family members in rural areas. Poor families struggle to raise this money and often resort to borrowing or mortgaging household assets to meet festival expenses (personal communication, February 7, 2020).

Seasonal economic stresses, such as price hikes and limited employment opportunities are also common in Zimbabwe and they are usually caused by seasonal agricultural production and festival cycles (personal communication, January 14, 2020). For instance, tobacco is a major source of foreign currency in Zimbabwe. During the post-tobacco-selling season, from late August to March, prices of basic goods and services usually rise as foreign currency—required for the importation of fuel, raw materials, medicines and other essentials—becomes scarcer (Sibanda, 2018). Job opportunities are also limited during the period and some workers get laid

off. Festivals, such as Christmas and New Year, fuel demand for groceries and clothing: this results in price hikes (personal communication, January 14, 2020).

Many climatic and non-climatic dimensions of seasonal poverty, previously outlined, occur at the same time and reinforce each other. For instance, seasonal hunger, human and cattle diseases, a shortage of money, weak social capital, back-to-school stresses and festival stresses all occur in the wet season, peaking in January. In Zimbabwe, January is the most stressful month of the year as people experience multiple seasonal realities, infamously referred to as 'January diseases'.

The characteristics of seasonal poverty in Cambodia

The nature of seasonal poverty in Cambodia also takes both climatic and non-climatic forms (Table 2). Seasonal hunger, in Cambodia, usually begins in August and extends to November (World Food Programme, 2010) and rural communities are the most affected. About two-thirds of the country's 1.6 million rural households experience seasonal hunger each year (Culas & Tek, 2016). This fuels food-price hikes as many households rely on the market for food (World Food Programme, 2010). To cope with seasonal hunger and the associated food price hikes, households increase their exploitation of common property; reduce the number of meals they eat each day and mothers and elder sisters eat less than others; borrow food and money; rely on help from outsiders; and increase migration for work, among other strategies (Cambodia Development Resource Institute, 2008; Tango International, 2019).

Table 2. Characteristics of seasonal poverty in Cambodia

Climatic realities	Non-climatic realities
Seasonal hunger	Back-to-school stresses
Low income from fishing	Festival stresses
Human diseases	
Snakebites	

Low income from fishing is also a wet-season reality faced by Cambodian communities, especially those in rural areas whose livelihoods are ‘fishing-dependent’ (Marschke & Berkes, 2006; Sok, 2013; Sok et al., 2014). Fish production, growth and migration are affected considerably by temperature and rainfall; thus, fish catches are lower during the rainy season and peak during the dry season (Joffre et al., 2010). The rainy season is a difficult period for communal fishers as fishing is disturbed by increased rains and storms (Marschke & Berkes, 2006).

Cambodia also experiences a higher incidence of some human diseases, such as malaria, dengue, diarrhea or dysentery, cholera, influenza, fever, and leptospirosis during the rainy season (Sotheary, 2019; Xinhua, 2018). Many rural Cambodians are also vulnerable to faecal infections as the practice of open defecation is rampant: Some people abandon their pit latrines during the rainy period due to odour problems, unhygienic conditions, flooding and collapse (Chambers, 2012; Kunthy & Catalla, 2009; Robinson, 2012).

Floods in Cambodia are seasonal, they are caused by monsoonal rains and the Mekong River flood pulse (Mekong River Commission, 2015; Saulnier et al., 2018). The flood season typically runs from July to October (World Food

Programme, 2010). In rural areas, floods constrain the access of clean drinking water for the poor, destroy properties, diminish fishing opportunities, and results in a peak of diarrhea and other water-borne diseases (Jensen, n.d.). Moreover, floods affect school children from poor families more acutely as they struggle to access schools causing a high dropout rate and it can be common for classes to start late in the term (Asian Disaster Preparedness Center, 2008).

Snakebites in Cambodia, are also most common during the rainy season, especially in areas along the Mekong River and Tonle Sap floodplains (Bual, 2018; Cox, 2015). The country has at least 17 known species of venomous snakes, such as Malayan pit viper, cobra and krait (Cox, 2015). According to Bual (2018), *“snake bites hit the poorest of the poor: farmers who work barefoot in fields and people living in the most remote areas who have minimal access to health education and medical care.”*

Back-to-school stresses are a common non-climatic seasonal reality in Cambodia. They emanate from the school calendar. The first school-term, which runs from October to April, is the most challenging for poor families in the country, who experience financial stress resulting from the need to pay for new uniforms, books and other schooling materials as well as transport (Officer, Ministry of Tourism, personal communication, March 18, 2020; Student, Royal University of Phnom Penh, personal communication, March 26, 2020).

Festival stresses are another seasonal reality experienced by the poor in Cambodia (Officer, Ministry of Tourism, personal communication, May 9, 2020). It is worth noting that Khmer New Year (Cambodian New Year)

celebrations held around 14th April every year, have high cultural and religious significance (Officer, Ministry of Tourism, personal communication, May 9, 2020). The celebrations involve visiting relatives, hosting visitors, sharing special meals, exchanging gifts and giving to less privileged people. (Officer, Ministry of Tourism, personal communication, May 9, 2020). The poor rarely participate in many of the celebratory activities due to financial problems (Officer, Ministry of Tourism, personal communication, May 9, 2020).

Many of the seasonal realities explained above occur in the same season and interlink and reinforce each other. For instance, in the rainy season, seasonal hunger makes people less immune to seasonal diseases and at the same time families, especially, those who depend on fishing as a livelihood do not have income to buy food or seek medical help. At the same time, families struggle with raising money for back to school stresses and coping with floods.

Nature of seasonal poverty between Zimbabwe and Cambodia

As highlighted in the introduction, the nature of seasonal poverty is claimed to be context-specific. This study tests this claim by comparing the nature of seasonal poverty in Zimbabwe and Cambodia. The preceding sections have revealed information about seasonal poverty in each country. This section compares these results (Table 3).

In Cambodia, the study mainly accessed secondary data, which is hard to come by for the winter season and non-climatic seasonal realities. In the future, empirical studies will be needed for these aspects. Nevertheless, from the comparative analysis of seasonal poverty between Zimbabwe and Cambodia in Table 3; three observations were noted. First, Zimbabwe and Cambodia experience both climatic and non-climatic forms of seasonal

poverty. The nature of both forms of poverty is mostly the same in each country. For example, both countries experience seasonal hunger, a shortage of money during the rainy season, seasonal human diseases, snake bites and significant back-to-school stresses. There are, however, seasonal realities that are peculiar to Cambodia, such as realities induced by seasonal floods.

Second, seasonal poverty in Zimbabwe and Cambodia is complex: the realities interlock and reinforce each other. For instance, in both countries, seasonal hunger weakens the immune system of the poor making them more vulnerable to seasonal human diseases. Additionally, seasonal hunger fuels food price hikes, which occur at a time when the poor generally lack income basic needs. This causes difficulties in meeting back-to-school expenses.

Third, seasonal poverty is more pronounced in the wet season in both countries. Many of the seasonal realities highlighted in this study are more intense during the rainy season. Interestingly, climatic seasonal poverty realities, such as seasonal hunger, seasonal human diseases, and snake bites coincide with non-climatic seasonal poverty realities like back-to-school stresses. As an illustration, seasonal poverty in Zimbabwe and Cambodia occurs in both cases during the wet season. Based on these observations, this study concludes that the nature of seasonal poverty in Zimbabwe and Cambodia is similar to a large extent. As outlined in the introduction, the contextual disparities between Zimbabwe and Cambodia are remarkable. Thus, the claim that the nature of seasonal poverty varies according to context is considered inaccurate.

Table 3. Comparison of seasonal poverty between Zimbabwe and Cambodia

Zimbabwe	Cambodia
<i>Climatic Seasonal Poverty</i>	
<i>Wet season (October - April) realities</i>	<i>Wet season (May - October) realities</i>
<ul style="list-style-type: none"> - Seasonal hunger - Seasonal human diseases - Snake bites - Shortage of income & indebtedness - Uncomfortable houses - Transport challenges - Weak social capital - Cattle diseases 	<ul style="list-style-type: none"> - Seasonal hunger - Seasonal human diseases - Snake bites - Low income from fishing - Flood-induced realities
<i>Winter season (May -September) realities</i>	<i>Winter season (November to February/March/April realities</i>
<ul style="list-style-type: none"> - Winter health problems (colds and flu) - Price hikes for blankets and winter wear 	<ul style="list-style-type: none"> - No data
<i>Non-climatic Seasonal Poverty</i>	
<ul style="list-style-type: none"> - Back-to-school stresses (<i>January</i>) - Festival stresses (<i>December and January</i>) - Seasonal economic stresses (<i>August/September to March</i>) 	<ul style="list-style-type: none"> - Back-to-school stresses (<i>beginning of the first term, around October</i>) - Festival stresses

Policy recommendations

The alleviation of seasonal poverty starts at the policy level, where it may be integrated into the design of poverty eradication efforts (Devereux, 2012; Longhurst et al., 1986). For Zimbabwe, Cambodia and other developing countries to reduce seasonal poverty, it must be considered from the conception to the termination of both policies and programs. Seasonal

realities are evitable; hence, the focus should be on minimizing the effects of seasonal poverty on livelihoods through the implementation of social protection programs, such as cash and asset transfers and food aid programs. Social protection programs prevent the sale of household assets or the borrowing of money to cope with seasonal stresses. Moreover, the programs that strengthen the negotiating power of the poor should be considered as they help address poverty traps. The policies or programs should be local, flexible and timely in approach if they are to effectively reduce the effects of seasonal poverty (Conroy & Vignon, 2012; Longhurst et al., 1986). This implies that the design of social protection programs should be decentralised and implemented at the onset of seasonal realities.

Poverty reduction policies or programs should also focus on enhancing the resilience of the poor to the effects of seasonal realities and not weaken existing coping mechanisms (Conroy & Vignon, 2012; Longhurst et al., 1986). The policies or programs should be designed and implemented in a way that the livelihood opportunities that poor people use to cope with and recover from the adverse impacts seasonality are strengthened. This will enhance the resilience of the poor to the effect of seasonal realities.

Conclusion

This study examines the nature of seasonal poverty in Zimbabwe and Cambodia and analyzes whether seasonal poverty varies between each country. The intention was to test the claim that the nature of seasonal poverty varies according to context. It found that the nature of seasonal poverty in Zimbabwe and Cambodia is, by and large, similar. Both countries experience climatic and non-climatic forms of seasonal poverty, which include

seasonal hunger, human diseases, insufficient income, snake bites and onerous back-to-school expenses. However, there are seasonal realities that are unique to Cambodia, such as flood-induced realities. The complexity of seasonal poverty in both countries is also similar. The seasonal realities noted in Zimbabwe and Cambodia interlink and reinforce each other in the same way. In both countries, climatic and non-climatic seasonal realities are more noticeable during the wet season. Thus, this study concludes that the claim that seasonal poverty is context-specific is not factual.

Regarding the reduction of seasonal poverty in Zimbabwe, Cambodia and other developing countries, this study recommends that the seasonal dimension of poverty should be factored into the design and implementation of poverty eradication policies. As seasonal poverty is inevitable, these policies should focus on two aspects. Firstly, they should strive to minimize the effects of seasonal poverty on livelihoods and the dignity of poor people. This may be achieved through the implementation of social protection programs that enable the poor to avoid desperate coping measures to manage seasonal stresses. These programs should be designed at a local level and implemented before the onset of seasonal realities. Secondly, policies should aim to enhance the resilience of the poor in response to the effects of seasonal realities. This may be achieved through poverty reduction programs that bolster livelihoods that the poor adapt to cope with the adverse effects of seasonality.

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Sources of income in rural households at Kdol Tahaen Commune, Bavel District, Battambang

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ភាពក្រីក្រនៅប្រទេសកម្ពុជាច្រើនប្រមូលផ្តុំនៅជនបទ។ ដូច្នោះ ការកាត់បន្ថយភាពក្រីក្រទូទាំងប្រទេសតម្រូវឱ្យមានការកាត់បន្ថយភាពក្រីក្រនៅតាមទីជនបទ ដោយបង្កើនប្រភពផ្សេងៗនៃប្រាក់ចំណូល។ ការសិក្សានេះបានប្រើកម្រងសំណួរផ្លូវការ ដើម្បីស្រាវជ្រាវរកប្រភពប្រាក់ចំណូល និងកត្តាផ្សេងៗដែលជះឥទ្ធិពលដល់ការបង្កើតប្រាក់ចំណូលក្នុងឃុំមួយនៅជនបទនៃខេត្តបាត់ដំបង ភាគពាយព្យនៃប្រទេសកម្ពុជា។ លទ្ធផល បានបង្ហាញថា ប្រាក់ចំណូលពីការងារកសិកម្មមានប្រមាណ ៦៨% នៃប្រាក់ចំណូលសរុបរបស់គ្រួសារដែលរស់នៅក្នុងឃុំនោះ។ ចំណែកប្រាក់ចំណូលដែលបានមកពីប្រភពផ្សេងក្រៅពីការងារកសិកម្មមានចំនួនតិចតួចប៉ុណ្ណោះ។ អ្នកភូមិដែលមានប្រភពប្រាក់ចំណូលក្រៅពីកសិកម្ម ច្រើនប្រកបមុខរបរក្រៅប្រព័ន្ធដូចជាការលក់ដូរតូចតាច និងការងារសំណង់។ មានអ្នកភូមិតែមួយចំនួនតូចប៉ុណ្ណោះ ដែលប្រកបការងារផ្លូវការដូចជាពេទ្យភូមិ គ្រូបង្រៀន ឬទាហាន។ លទ្ធផលទាំងនេះបង្ហាញថា ការខិតខំលើកកម្ពស់ជីវភាពប្រជាពលរដ្ឋនៅជនបទត្រូវផ្តោតលើការបង្កើនតម្លៃចំពោះផលិតផលកសិកម្ម តាមរយៈការលើកកម្ពស់ផលិតភាព ឬបង្កើន

តម្លៃបន្ថែម តាមរយៈដំណើរការកែច្នៃចំណីអាហារ ឬសកម្មភាពឧស្សាហកម្ម
ដ៏ទៃទៀត។ មិនតែប៉ុណ្ណោះ ការធ្វើពិពិធកម្មប្រភពចំណូលផ្សេងៗក្រៅពី
ការងារកសិកម្មតាមរយៈ ការបង្កើតការងារដែលមិនទាមទារជំនាញខ្ពស់ក៏
សំខាន់ដែរ។

Abstract

Poverty in Cambodia is largely a rural phenomenon. Thus, creating sources of rural income to address rural poverty is required to reduce national poverty. This study used a structured questionnaire to explore the sources of income and the factors affecting income generation of a rural commune in Battambang Province, in the northwest of Cambodia. It was found that 68% of total household income in the commune was from agricultural sources, while there were very few sources of non-agricultural income. Villagers who sourced non-agricultural income, generally worked informally conducting activities such petty trade or manual labor for construction projects. Very few villagers engaged in formal employment, and those who did were in occupations such as doctors, teachers, or soldiers. These results suggest that efforts to improve rural livelihoods should focus on adding value to agricultural production via food processing or other industrial activities. Additionally, it is important to create diversified sources of alternative, non-agricultural income via low- or semi-skilled employment.

Keywords: rural livelihoods, agricultural income, non-agricultural income, poverty, Cambodia

Introduction

Rural households in developing countries are generally worse off than their urban counterparts, with respect to many indicators such as access to education, healthcare, markets and infrastructure. They also tend to control fewer assets (Jazairy et al., 1992; Alkire et al., 2014; Maccourse and Swinnen, 2008). As a result, rural poverty reduction can be difficult endeavor, with no

one-size-fits-all solution (FAO, 2017). However, poverty reduction is part of the global development agenda. It was specifically targeted as part of the Millennium Development Goals (MDGs), which committed to halving the number of people living on less than 1.25 USD per day by 2015. Poverty reduction is also a feature of the post-2015 development goal, i.e., the Sustainable Development Goals (SDGs), which UN member states committed to achieve by 2030. The first goal, “No Poverty: end poverty all its forms everywhere”, includes seven targets. The first target is to eradicate poverty, currently measured by the 1.25 USD poverty line, and the second target is to reduce at least by half people who live in poverty in all its dimensions according to national definitions. Cambodia has also made a commitment to meet the SDGs.

Different national policies have produced different outcomes, with respect to poverty reduction. For instance: China was able to reduce poverty by 2.5 % per annum between 1999 and 2015; Vietnam managed a 1.9% annual reduction in poverty between 1998 and 2016; and Pakistan realized a 1.8% average annual reduction between 2001 and 2015 (World Bank, 2019). Nonetheless, a common approach to poverty reduction is to develop a detailed understanding of the socio-economic conditions of the country, then to seek to eliminate poverty through formulating effective policies (Engvall et al., 2008). Data on how the poor generate income, and the assets they own are important for policy makers to this end. For instance, if the poor possess limited skills, a policy of creating labor-intensive industries may be adopted; whereas if the poor are heavily engaged in agriculture production, a policy of developing food processing industries may be promoted (Khan, 2000).

Cambodia has sustained an annual average growth in GDP of 7.8% between 2000 and 2018 (ADB, 2019). Despite this, the country remains one of the poorest in Southeast Asia (World Bank, 2020) and has only recently graduated from low-income to lower-middle-income country status (World Bank, 2016). Poverty in Cambodia is more prevalent in rural areas and in 2014, it was estimated that 90% of the people living below the poverty line in the country lived in rural areas (World Bank, 2020). By 2018, the overall national poverty rate had been reduced to 12.8% (ADB, 2020). However, the most up-to-date rural poverty rate (20.8%) was shown to be more than three times the urban poverty rate (6.4%) (World Bank, 2020).

It is vital for policy makers who aim to reduce poverty to understand the context of poverty and recognize that the poor are not homogenous. Different categories of poor require specific policy interventions (Khan, 2000). For instance, information about the sources of income generation by the poor is often important for informing policies that reduce monetary poverty (Stewart et al., 2007). This study explores the socio-economic conditions of rural Cambodian households using a case study in Kdol Tahaen Commune in Bavel District, Battambang Province. It considers the range of income sources found in the commune and the factors that affect household incomes.

Study area and research methods

This study used data obtained from a household survey conducted in seven villages in Kdol Tahaen commune in Bavel District, which is one of 14 districts in Battambang Province. There are 24 provinces in Cambodia, as well as the capital, Phnom Penh. Each province is sub-divided into districts and communes. Communes are the lowest administrative hierarchy and unlike

officials at the provincial and district level, a Commune Council is elected by citizens for a term of five years. Battambang province was selected for the study on the basis of its importance to the Cambodian economy and the range of economic activities present, including agriculture, trade, tourism and fisheries. The province is known as Cambodia's rice bowl and produces a significant proportion of the country's rice (Chon & Thet, 2011; Gartell, 2010). For instance, in the 1950's and 1960's following Cambodia's independence from France, Battambang alone produced sufficient rice to feed the entire population (Chon & Thet, 2011). The province is well-known for its fertile land, and rice produced in the province has a reputation for being of high quality. Farmers can usually obtain premium prices in both domestic and international markets for their rice output as a result (Chuon and Suzuki, 2005).

Battambang has a lot of other economic potential. It comprises part of the area surrounding the Tonle Sap, which is one of the most productive inland freshwater fisheries in the world (Lamberts, 2001). It also shares a border with Thailand and is a major route for trade and migration with Thailand. Many villagers from Battambang traverse the border to access alternative incomes through low-skilled jobs in Thailand. However, despite these favorable conditions, a relatively high proportion of provincial population (32.6%) had ID Poor 1 or ID Poor 2 status in 2017 (MoP 2018; cited in Sok and Chhinh, 2018). Bavel is one of the poorest districts in the province based on socio-economic indicators, such as access to electricity, housing type, and TV ownership (Provincial Department of Information, Battambang, 2016). Kdol Tahaen commune was selected as the site for the research, being a rural commune in this district.

Systematic sampling was used to select households for the study. Enumerators, upon selecting the first household to be surveyed, would then skip the next five households, meaning that every sixth household was included in the survey. This process was repeated until a quota for the number of households to be interviewed in each village was reached. Each enumerator was trained prior to data collection to ensure a consistent approach, before being assigned to conduct a pilot survey. Upon satisfactory results being obtained, the actual survey commenced. Although it is acknowledged that a larger sample size would have been preferable, resource limitations meant that only 150 households were surveyed over a period between the 1st and 3rd of November 2017. Following processing and cleaning of the data, only 116 households remained, after observations missing results for significant variables were excluded from the data set. This means that care should be taken when making generalizations using results from this survey. Beyond the limited sample size, the socio-economic conditions of people in Kdol Tahaen commune may vary from those located along the plain, or in mountainous or coastal regions.

As mentioned, the study comprises of two objectives. The first, to explore the income sources of rural Cambodian households, was assessed using descriptive statistics; whereas the second, to determine the factors that affect income generation, was assessed using regression analysis. A regression equation (1) was used to assess the significant determinants of rural household income. It included many factors outlined in the literature as influencing household income such as asset ownership, household socio-

economic conditions, access to local resources (Aikaeli, 2010), as well as government policies (Winters et. al., 2002).

$$Y_i = \beta_0 + \beta_1 Age_i + \beta_2 Gen_i + \beta_3 Edu_i + \beta_4 Dep_i + \beta_5 Catt_i + \beta_6 Ht_i + \beta_7 TV_i + \beta_8 MB_i + \beta_9 MP_i + \beta_{10} ELE + \beta_{11} PR_i + \varepsilon_i$$

(1)

A detailed explanation of the independent variables in this equation and their expected correlations with the dependent variable are presented in Appendix 1. Table 1, below, presents selected data from the field survey. It demonstrates that within the study site, the average age of a household head is 42-years, which is common in rural areas of Cambodia. Each household has on average 5 members, which is within the range of the 2013 national average of 4.6 members (National Institute of Statistics, 2013). Most household heads had only access a low level of education, with 67% of respondents educated to primary school level only. University qualifications were very rare among the survey cohort. The importance of agriculture to household income and the sparse population in the district is represented in the results that show that the average size of land owned is 2 hectares per household.

Bavel is known to be one of the poorer districts in Battambang, which is supported by the results of the survey. It indicates an average per capita income of 3,400 KHR, which is significantly lower than the 2009 rural poverty line of 3,503 KHR (4,500 KHR or 1.12 USD in 2017) (P -value=0.001) (MoP, 2013; ADB, 2017). There are four different poverty lines recorded in Cambodia. These are disaggregated for rural areas, Phnom Penh, as well as urban areas, and includes an aggregate national poverty line. However,

difficulties in accurately assessing rural incomes, due to their irregularity and multiple sources are worth noting.

Table 1. Demographic and socio-economic characteristics of households

Variable	Mean	Std. Dev.	Min	Max
Age of household head	41.920	12.687	20.000	80.00
<i>Education level (HH head)</i>				
Primary (dummy)	0.672	0.471	0.000	1.00
Lower secondary (dummy)	0.129	0.337	0.000	1.00
Upper secondary (dummy)	0.017	0.131	0.000	1.00
University (dummy)	0.009	0.093	0.000	1.00
Daily per capita income (KHR)	3,392	3,814	137	20,000
Household members (persons)	4.888	1.763	2.000	10.00
Microfinance access (dummy)	0.164	0.372	0.000	1.00
No. of dependents (person)	1.655	1.266	0.000	5.00
Agricultural land (hectare)	2.2	1.797	0.300	12.00

While an effort was made to encourage respondents to provide information about all sources of income, they may not have all been recorded. Another potential reason for low monetary income in the case study, is that many of the productive activities of rural households are not recorded through market transactions. For instance, household members, grow and consume vegetables, fish, chicken, and eggs self-sufficiently. Thus, while a low monetary income was recorded, this may not correlate with an insufficient calorie intake or an experience of poor wellbeing.

Results and findings

Rural sources of income

Agriculture remains to be the major source of income for the households interviewed. Figure 1 shows that agricultural activities account for approximately two-thirds of total household income. All households grow

rice; while some also grow corn to generate additional income. Some also engage small-scale vegetable production for household consumption. Figure 2 identifies seven non-agricultural income sources. This include four formal employment pathways, including the army, medical practice, teaching, and working in local administration as well as three informal income sources.

Figure 1. Income share of rural HH

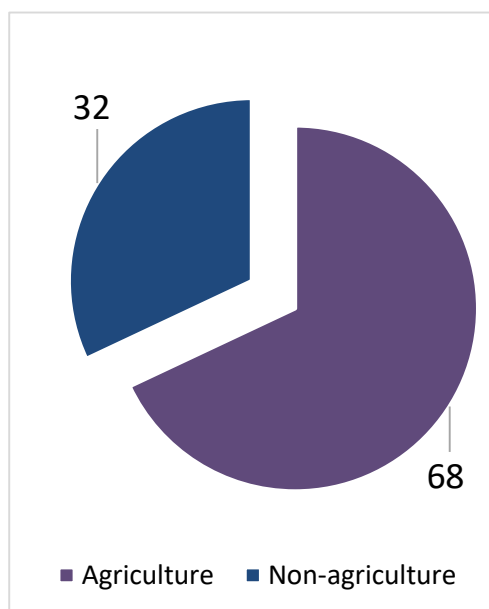
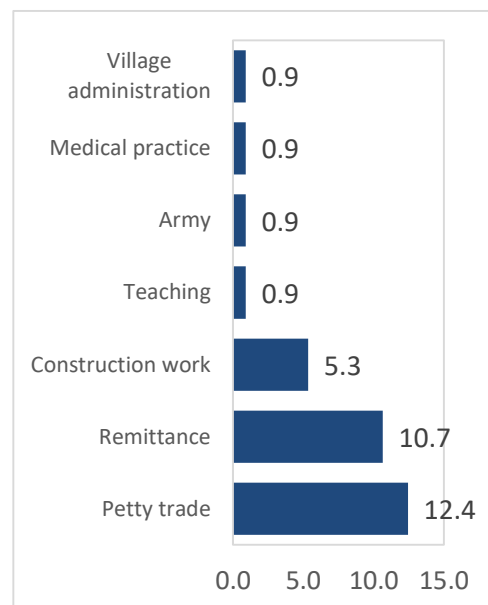


Figure 2. Non-agricultural income



While a variety of formal non-agricultural jobs were identified, the number of people working in informal roles was much higher, comprising about 90.0% of income generated from both within and outside of the agricultural sector. It is worth noting that one of the major sources of non-agricultural income was remittances from members of rural households working in urban centers or abroad. Due to an increasing numbers of household members, pressure on land resources coupled with low agricultural productivity, and shortage of off-farm employment; many younger people migrate to cities or foreign countries. Many villagers

identified that young people migrated as they did not have employment and had nothing else to do.

Ownership of rural assets

The average size of agricultural land of the households surveyed was 2.2 hectares. With an average household size of 4.9 persons, this corresponds to average land area per capita of 0.5 hectares. This result is larger than the national average as Battambang is relatively sparsely populated when compared to other provinces. The results of a t-test used to compare the ownership of other assets by both male and female-headed households is shown in Table 2. In most cases, there was no statistically significant difference in ownership.

Table 2 also provides data about the construction materials used in the homes of each household. It shows that most households had a corrugated zinc roof, while a much smaller proportion had a roof made with leaves, or were constructed from concrete. However, it should be noted that while both better-off and the poorer households used the same construction materials and had the same type of house, the size of the house and quality of materials may differ. For instance, when corrugated zinc houses were constructed, the size of the house constructed by wealthier families were much larger, using better quality timber. Thus, the value of different houses of the same type may vary significantly in each village.

No statistically significant difference in the size of landholdings by male and female-headed households was found (P -value=0.701). However, when the type of construction materials used in houses was compared with respect to the gender of the household head, there were some minor differences. For example, more female-headed households owned leaf-roof houses and fewer

owned houses with a corrugated zinc roof. Although it is apparent that more female-headed households owned concrete houses, the total number of villagers who owned these houses was negligible and this difference was not statistically significant.

Table 2. Land ownership, household construction materials, and access to electricity

Attributes	Overall	Male	Female	P-value
<i>Land ownership (hectares per household)</i>				
Agricultural land	2.2	2.1	2.2	0.701
<i>Housing (%)</i>				
Corrugated zinc roof	84.5	87.0	82.3	0.478
Leaf roof	9.5	9.3	9.7	0.939
Concrete house	3.5	3.7	3.2	0.888
Other	2.6	0.0	4.8	0.012**
<i>Assets (%)</i>				
Radio	38.8	35.2	41.9	0.457
TV	50.0	42.6	56.5	0.137
Mobile phone	77.6	72.2	82.3	0.196
Bicycle	69.0	70.4	67.7	0.760
Motorbike	55.2	53.7	56.5	0.767
Car	2.6	1.9	3.2	0.642
Power tiller	43.1	51.9	35.5	0.076*
Tractor	1.7	0.0	3.2	0.183
Cattle	59.5	66.7	53.2	0.141
<i>Sources of electricity power (percentage)</i>				
Electricity access	49.1	53.7	45.2	0.359
Solar energy	7.8	3.7	11.3	0.128

Note: ** and * significant at 5% and 10% respectively

Only 50% of the households surveyed had access to electricity and only 7.8% had access to solar energy. In terms of other asset ownership, 77.7% of households owned a mobile phone, followed by a bicycle (69%), cattle (59.5%), a motorbike (55.2%) and a TV (50%). It was also shown that there

was no statistically significant difference between the ownership of these assets and the gender of the head of the household. The one exception to this was that male-headed household were much more likely to own a power tiller. This asset is used for agricultural production and requires physical strength to operate. Power tillers are also used as a means of transportation and a substitute for tasks previously aided by cattle. Owners of these hand tractors could also often generate extra income renting them to other villagers.

Determinants of rural income

Although most of the independent variables examined in the study did not demonstrate any statistical significance, this was probably due to the limited sample size. Thus, these results mainly indicate the nature of the relationship between income and socio-economic status in rural households. The results of three regressions, with three different dependent variables are displayed in Table 3. For the first regression, a natural logarithm of total household income was the dependent variable. For the second regression, a natural logarithm of total non-agricultural income was used. For the third regression, natural logarithm of agricultural income was used.

The difference between the sign of the coefficient for mobile phone ownership in Regression 2 and Regression 3 should be noted. According to these results, mobile phone ownership tends to be associated with increased agricultural income but reduced non-agricultural income. This suggests that in rural areas, ownership of a mobile phone enables farmers to better access information about prices and contact middlemen to sell their products. As

expected, ownership of a power tiller was shown to be positively associated with increased agricultural income in the third regression.

Table 3. Determinants of income

Explanatory variables	Dependent variable: <i>Total income</i> (1)	Dependent variable: <i>Non-agricultural income</i> (2)	Dependent variable: <i>Agricultural income</i> (3)
Age	0.004 (0.008)	-0.003 (0.062)	0.019 (0.049)
Gender	-0.310 (0.221)	-1.858 (1.578)	-0.188 (1.284)
Edu_univ	1.321 (1.157)	12.760 (8.267)	3.864 (6.715)
Edu_secondary	-1.108 (0.833)	-5.151 (6.126)	3.293 (4.835)
Edu_lower secondary	-0.167 (0.392)	-1.005 (2.817)	1.520 (2.278)
Edu_primary	-0.081 (0.307)	-0.632 (2.245)	0.0962 (1.781)
Dependents	-0.359 (0.463)	-0.001 (3.364)	-0.976 (2.688)
Cattle	-0.321 (0.230)		-0.966 (1.335)
Power tiller	-0.273 (0.219)		2.429* (1.268)
TV	-0.234 (0.242)	-1.803 (1.779)	-0.948 (1.402)
Motorbike	-0.023 (0.247)	0.968 (1.801)	-2.139 (1.434)
Mobile phone	0.038 (0.265)	-3.539* (1.924)	2.822* (1.536)
Electricity	0.262 (0.230)	1.677 (1.657)	-0.095 (1.335)
Paved road	-0.053 (0.252)	-1.957 (1.809)	1.871 (1.462)
Microfinance	-0.001 (0.288)	1.268 (2.118)	-1.210 (1.669)
R-squared	0.114	0.086	0.137
Adjusted R ²	-0.023	-0.034	0.003
	F(15, 97) = 0.83	F(13, 99) = 0.72	F(15,97) =1.03
Observation	113	113	113

Note: **: P< 0.05, and *: P<0.1

Discussion

Sources of income for rural households

This study shows that income from agriculture accounts for a high proportion of total income in rural Battambang. While non-agricultural income sources exist, they are less available and restricted to informal employment in petty trade or construction work. Remittances have recently become a much more significant source of income for rural households. Battambang province shares a border with Thailand and it is easy for residents to migrate to access work. To increase the income of rural households, Winter et al. (2009) suggests that the improvement of three important rural assets, including agricultural land, rural infrastructure, and education is vital. In the study site, households were found to own a relatively large area of agricultural land due to a low population density. However, access to electricity infrastructure had not yet been provided, with only 49.1% and 7.8% of households having access to the electricity grid and solar energy, respectively.

Previous studies have shown that rural electrification tends to increase household income, improve household welfare (Kooijman-van Dijk, 2012; Rao, 2013), and increase the profitability of rural micro-enterprises (Akpan et. al., 2013). Electricity access also allows households to access better information through the use of televisions or mobile phones. Mobile phone ownership has been found to reduce the cost of marketing farm products and encourage farmers to actively participate in markets (Muto and Yamano, 2009). It also has been shown to strengthen the capacity of rural households to deal with emergencies and expand their social networks (Sife et. al., 2010).

Recently, as prices have decreased, mobile phones have become affordable for rural households in Cambodia, resulting in many benefits.

Electricity access has recently expanded in Cambodia, however there is a persistent gap in access between urban and rural households, which suggests that rural electrification programs should be prioritized. While 97.0% of Cambodia's urban population has access to electricity, this is true for only 49.0% of the rural population (Surrusco, 2017). Many rural households are restricted to using home solar systems, solar lanterns, and rechargeable batteries (World Bank, 2018), which provide less stable service at a higher cost.

A better outcome would be if rural households could access more reliable electricity sources, such as through a national grid. Prices should be set at a rate that enable poor households to afford access to electricity. Current tariffs in Cambodia are among the highest in ASEAN countries, and in rural areas, the cost tends to be higher than in cities. For instance, while in some parts of Phnom Penh residents pay 18 cents per kWh for electricity, some rural residents pay as much as 1 USD per kWh (Poch and Tuy, 2012). Higher electricity costs in rural villages are attributed to the fact that the national grid does yet reach many villages and electricity is often supplied by a private company in these cases. As a result, many rural households still cannot access electricity.

Besides enabling farmers to increase the size of their land holdings and improve the productivity of their labor, better access to education offers a chance for the rural poor to take advantage of opportunities for off-farm income-generation. However, the study shows that the average levels of

schooling accessed by household heads in the study site is mostly limited to primary education. This makes it difficult for farmers to understand and apply modern agricultural techniques, let alone find a formal job outside of agriculture.

Despite this, providing formal education to adult farmers would be both time-consuming and impractical. Many of the rural poor are not likely to be able to invest time in participating in formal education. An alternative would be to provide training opportunities on agricultural methods and other practical skills that may be applied locally to generate income. Beyond this, it is vital to provide quality education in rural areas so that children in rural households will be able to better access off-farm income-generating activities and participate in higher value labor opportunities in the future. Households with more highly educated members may also benefit indirectly via the transfer of new knowledge and technologies. Although education was not found to significantly affect income in this study, it is still considered to be an important factor in improving and diversifying the income sources of rural households. Poorer and lower educated households (Escobal, 2001), particularly those from more remote villages tend to be less diversified (Abdulai and CroleRees, 2001). Additionally, when they do diversify their income sources, it tends to be with low-paid employment (Rahut & Micevska Scharf, 2012; Woldenhanna, & Oskam, 2001).

Diversifying and increasing sources of rural income

The main sources of income in this study were found to be dominated by agricultural activities and informal jobs such as petty trade and construction. Thus, policies that either add value to agricultural production or

create new sources of income are most likely to improve household incomes among the rural poor. However, agricultural production in Cambodia tends to be less diverse, with most farmers growing only rice. While a few farmers grow corn and other vegetables on a small-scale, rural people are not generally encouraged to diversify further as there is little demand for products. This introduces higher levels of risk for those who try. Yet, not diversifying production leads to an oversupply of commonly grown crops, while there is a shortage of other produce. Oversupply occurs frequently, which makes it harder for the rural poor to access profitable markets.

This tends to cause indebtedness among farmers, who generally borrow money to invest in agricultural inputs such as seeds, fertilizer, and gasoline. Tan (2017) outlines how farmers tend to access microfinance for paying for inputs that they will not be able to repay. Many Cambodian agricultural products, including rice and corn, are often sold to neighboring countries such as Thailand and Vietnam, in a fashion that gives middlemen the power to set prices at a lower rate than what is reasonable for local farmers (Chan, 2014b). This may be attributed to the lack of a food processing industry in Cambodia, where there are very few factories available to process and market raw agricultural products. Meanwhile, it is easy to find imported processed foods in the country.

While crops like rice and corn are frequently in oversupply with depressed prices, there is also substantial volumes of agricultural products imported from neighboring countries. Currently, Cambodia imports 200 million USD worth of vegetables from Vietnam, Laos and Thailand annually (VOV, 2016). Farmers will be able to benefit substantially if they are able to

meet local demand for these products that are currently imported. However, this requires support to be provided to the rural poor, as vegetable farming can be more difficult than rice cultivation, which has been practiced for centuries in Cambodia (Chan, 2014a).

Diversified agriculture production will help farmers to reduce the oversupply of agricultural commodities and increase rural incomes via high value crops. Moreover, if food and other processing industries are developed, farmers will be able to benefit from more stable demand from markets. A viable food processing industry enables products to be stored for longer periods and enables them to be retained when market demand is low. Additionally, processing industries will create low or semi-skilled jobs, suitable for a large number of rural laborers in Cambodia. Thus, it is important to promote food processing businesses and the diversification of crops in areas with similar socio-economic conditions to the study site. Importantly, the national government has identified the importance of the food agribusiness sector and incorporated the promotion of this sector into the Industrial Development Policy (Chan, 2015).

Increasing off-farm income sources

One reason the income of rural households is low because they are engaged in activities that have low productivity with little value added. Additionally, there is a shortage of alternative income sources. This research identified very few informal sources of off-farm income, and only a few formal sources in the study area. This employment is not sufficient to meet the employment demand. The shortage of alternative employment in rural areas occurs from both a demand and supply perspective. On the demand side,

companies and factories are not interested in setting up facilities in the rural areas due to a lack of infrastructure. For instance, electricity is expensive, and the supply is unstable, resulting in higher costs of production. Roads are not well paved, so the transportation of products is not efficient. Thus, operating costs tend to be much higher for factories in rural areas. On the supply side, there is a lack of a skilled labor force. In the study site, the average level of schooling accessed is less than 6 years. Many people with this level of education cannot be employed in local government or on factories demanding pre-requisite skills.

An educated labor force is a key factor in being able to attract private firms to set up facilities. However, rural households should not be blamed for their low education. Rural villagers may perceive higher education to be unnecessary due to the current nature of their employment. Based on their experience of working in the agricultural sector as their family has done for multiple generations, many think that it is not necessary to access more than a primary education, as basic literacy is all that is required to access many rural jobs.

In this situation, government interventions to increase the level of education of the rural population is important if off-farm employment opportunities are to be increased. The government needs to encourage the people to either enroll in formal schooling or informal training centers. For most adult villagers, the former is not practical, thus, informal training needs to be provided. It is the role of government to encourage private firms to locate themselves in rural areas by supplying them with physical infrastructure required, as well as a skilled workforce and other preferential

treatment. In the short-to-medium term, creating a low-skilled employment that matches the available labor supply in rural areas via agricultural diversification and food processing will be necessary to absorb a large number of workers that have only had access to a primary-level education. However, in the long term, the next generation of rural villagers may be able to diversify into other higher value-added industries such as manufacturing and tourism.

Conclusion

Improving the income and welfare of the population is a priority for all governments. Concerted efforts have been made globally to mobilize resources and formulate policies to reduce poverty. However, this task is difficult and still far from complete. Hundreds of millions of people still live below the poverty line globally, despite substantial improvements since the inception of the Millennium Development Goals. To formulate effective poverty reduction policies, questions must be asked such as: Who are the poor? What resources do they have access to? And how do they make a living? This knowledge is vital as it provides policy makers with clear targets to meet. The rural poor face different challenges to their urban counterparts and require different support. This is also true for rural poor citizens who are landless compared with small-scale farmers who own land resources.

In Cambodia, majority of the poor live in rural areas. Most own at least a small plot of agricultural land, albeit decreasing in size. This is due to an increasing number of members in each household and the need to sell land in emergencies, such as when family members get sick. The rural poor are relatively low-skilled, with access to education in most cases limited to primary school. Primarily, they generate income from agriculture and other

informal sources such as petty trade or working on construction sites. Therefore, if incomes are to be increased to reduce rural poverty, it is necessary to diversify agricultural production and create sources of non-agricultural employment, at least in the short and medium term. Diversifying agriculture will result in farmers growing a broader variety of cash crops to avoid oversupply. Meanwhile creating non-agricultural employment in rural areas will enable households to access alternate sources of income during the off-season, potentially reducing the need for younger family members to migrate for work. The promotion of the food processing industry will provide opportunities through adding value to agricultural production, as well as providing employment for low-skilled labor in rural areas.

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Appendix 1. Regression variables and their explanation

Variable	Variable Name	Coefficient Sign	Explanation
<i>Y</i>	Natural log of household income (total income, agricultural income and non-agricultural income)		
<i>Age</i>	Age of household head	+	Age is expected to have a positive impact on income.
<i>Gen</i>	Sex of household head	+	A household headed by men is expected to generate higher income.
<i>Edu</i>	Education of household head	+	Education is expected to have a positive impact on income.
<i>Dep</i>	Dependency ratio	-	Dependency ratio is expected to have a negative impact on income
<i>Catt</i>	Ownership of a cattle (cow or buffalo)	+	Cattle can be used for agricultural activities such as plowing or transportation, so it is expected to be positively related to income.
<i>Ht</i>	Ownership of hand tractor	+	Power tiller is one of the most important machinery in rural areas. It is expected to be positively related to income.
<i>TV</i>	Ownership of Television	+	TV is a source of information including weather forecasts, prices of crops, and so on. Thus, it is expected to positively correlate with income.
<i>MB</i>	Ownership of motorbike	+	A motorbike can be used as a means of transportation

			and contact, so it is expected to be positively correlated with income.
<i>MP</i>	Ownership of mobile phone	+	Mobile can be used for long distant contact and to access information about prices etc. So, it is expected to be positively correlated with income.
<i>ELE</i>	Access to electricity	+	Electricity allows households to use machinery and other tools, thus it is expected to be positively corrected with income.
<i>PR</i>	Paved road in the village	+	Paved road enables households to access to the market, so it is expected to be positively correlated with income.

Appendix 2. Correlation Matrix

Attribute	Log_Income	Age	Gender	Edu_Univ	Edu_Secondary	Edu_lower secondary	Edu_Primary	Dependence	Cattle	Hand tractor	TV	Motor-bike	Mobile phone	Elec-tricity	Paved road	Micro-finance
Log_income	1.000															
Age	0.045 (0.637)	1														
Gender	-0.045 (0.637)	0.086 (0.365)	1													
Edu_univ	0.148 (0.637)	0.016 (0.870)	0.099 (0.286)	1												
Edu_seconda-ry	-0.052 (0.578)	0.027 (0.773)	0.142 (0.129)	-0.012 (0.895)	1											
Edu_lower secondary	0.008 (0.929)	0.000 (0.997)	0.001 (0.993)	-0.036 (0.702)	-0.051 (0.586)	1										
Edu_primary	-0.045 (0.629)	-0.093 (0.329)	0.025 (0.787)	-0.134 (0.153)	-0.189 (0.041)	-0.552 (0.000)	1									
Dependence	-0.073 (0.438)	-0.208 (0.027)	0.044 (0.639)	-0.136 (0.145)	-0.098 (0.296)	-0.022 (0.813)	0.137 (0.143)	1								
Cattle	-0.198 (0.033)	-0.012 (0.897)	0.137 (0.144)	-0.113 (0.227)	0.109 (0.243)	-0.205 (0.027)	0.023 (0.809)	-0.067 (0.474)	1							
Hand tractor	-0.159 (0.089)	0.039 (0.678)	0.165 (0.077)	-0.081 (0.386)	0.152 (0.103)	-0.024 (0.797)	0.014 (0.881)	-0.179 (0.054)	0.222 (0.017)	1						
TV	-0.021 (0.823)	0.175 (0.065)	-0.138 (0.139)	0.093 (0.319)	0.133 (0.156)	-0.077 (0.411)	0.112 (0.239)	-0.169 (0.069)	0.018 (0.852)	0.104 (0.265)	1					
Motorbike	0.034 (0.719)	0.213 (0.024)	-0.027 (0.769)	0.084 (0.369)	0.119 (0.202)	0.141 (0.132)	-0.112 (0.231)	0.018 (0.847)	-0.144 (0.124)	0.085 (0.367)	0.347 (0.000)	1				
Mobile phone	0.015 (0.876)	0.065 (0.495)	-0.120 (0.199)	0.050 (0.593)	0.071 (0.448)	0.084 (0.371)	-0.023 (0.808)	-0.150 (0.108)	0.019 (0.835)	0.176 (0.059)	0.165 (0.076)	0.347 (0.000)	1			
Electricity	0.023 (0.805)	0.093 (0.327)	0.085 (0.363)	0.095 (0.311)	0.135 (0.149)	-0.019 (0.839)	0.172 (0.065)	-0.049 (0.603)	0.179 (0.055)	0.085 (0.366)	0.328 (0.000)	0.262 (0.005)	0.156 (0.094)	1		
Paved road	-0.000 (0.996)	0.148 (0.117)	-0.117 (0.211)	0.158 (0.091)	0.073 (0.436)	0.007 (0.939)	-0.259 (0.005)	-0.160 (0.086)	0.207 (0.026)	0.043 (0.651)	0.158 (0.091)	0.057 (0.541)	0.034 (0.716)	0.049 (0.597)	1	
Microfinance	-0.011 (0.904)	-0.014 (0.883)	-0.086 (0.358)	-0.041 (0.660)	0.120 (0.198)	0.177 (0.058)	-0.088 (0.347)	-0.006 (0.946)	-0.109 (0.243)	0.038 (0.685)	0.209 (0.024)	0.258 (0.005)	0.182 (0.051)	-0.016 (0.867)	0.058 (0.538)	1

Higher education in Cambodia: Engendered, postcolonial Western influences and Asian values

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សង្ខេប

ស្នាដៃស្រាវជ្រាវនេះមានគោលបំណងកំណត់រកនូវការជះឥទ្ធិពលជាប្រវត្តិសាស្ត្រ ពីខាងក្រៅប្រទេសលើវិស័យអប់រំឧត្តមសិក្សានៅកម្ពុជា និងរបៀបដែលឥទ្ធិពលនេះ ប៉ះពាល់តម្លៃប្រពៃណី និងទស្សនៈវប្បធម៌សង្គមក្នុងប្រទេស។ ការសិក្សានេះផ្តល់នូវ ទិដ្ឋភាពរួមនៃការជះឥទ្ធិពលបច្ចុប្បន្នពីប្រព័ន្ធអប់រំបែបសេរីភារូបនីយកម្មនៃបណ្តា ប្រទេសលោកខាងលិចមកលើការអប់រំឧត្តមសិក្សានៅកម្ពុជា។ ដោយផ្អែកលើការ រំលឹកទ្រឹស្តីបែបវិភាគលម្អិត ការសិក្សានេះរកឃើញរបៀបដែលតម្លៃប្រពៃណីនិងការ ប្រតិបត្តិជាប់ទាក់ទងគ្នាជាមួយឥទ្ធិពលទំនើបមកពីក្រៅប្រទេស។ ការស្រាវជ្រាវនេះ រកឃើញថា ការលេចឡើងនៃគំរូប្រព័ន្ធអប់រំបែបកូនកាត់គឺជាប់ទាក់ទងនឹងសង្គ្រាមរ៉ាំ រ៉ែនៅកម្ពុជា បានកើតឡើងតាមរយៈរបៀបវារៈអភិវឌ្ឍផ្សេងៗគ្នា ដោយឆ្លុះបញ្ចាំងនូវ ការតស៊ូប្រកបដោយតម្លៃប្រពៃណី កេរតំណែលវប្បធម៌ និងប្រវត្តិសាស្ត្រ។ អត្ថបទ ស្រាវជ្រាវនេះលើកឡើងនូវគំនិតគោល ៗសម្រាប់គោលដំហរគោលនយោបាយ កំណែទម្រង់ឧត្តមសិក្សាដោយឆ្លុះបញ្ចាំងពីគំរូកូនកាត់នេះដែលតស៊ូមតិសម្រាប់ឥទ្ធិពល វប្បធម៌ប្រពៃណីនិងឥទ្ធិពលប្រវត្តិសាស្ត្រដែលត្រូវបានលើកកម្ពស់ទន្ទឹមនឹងការជំរុញ ភាពទំនើបកម្ម។

Abstract

This research identifies the external historical influences on higher education in Cambodia and how this has affected local traditional values and socio-cultural perspectives. It provides an overview of the major contemporary Western neoliberal influences in this context. A critical review of the literature explores how traditional values and practices have interacted with these modern external influences. The paper finds that an emerging hybrid model has evolved in post-conflict Cambodia, formed via different development agendas, reflecting a struggle with traditional values, cultural heritage and history. The paper outlines a policy position for higher learning reform reflecting this hybrid model that advocates for traditional cultural, and historical influences to be promoted alongside a drive for modernization.

Keywords: higher education, Asian values, engendered postcolonialism, Western influences, Cambodia

Introduction

In post-conflict states, regime change may only show *“the gap between the new emerging discourses and old persistent practices”* (Fimyar, 2008, p. 572). This contextual reality can exhibit national instability, dependence on foreign aid, weak state institutions, and corruption that inhibits social, economic, and political transformations. Hence, higher learning models are linked to historical and political environments, as well as the socio-cultural context. From a transitional socio-political perspective, higher education policies and practice have become the terrain of competing interests that often manifests as political symbolism (Jansen, 2002).

Models from the developed countries, such as the USA, UK, France, and Australia have strongly influenced the development of higher education institutions (HEIs) in Asian nations, such as Japan, South Korea, and Singapore;

as well as developing Asian economies, namely, Cambodia, Laos, Myanmar, and Vietnam. This influence has been exerted as a result of colonization, as well as structural adjustment policies linked to overseas development assistance. Academic literature has focused on identifying whether Asia has its own higher learning model (Arnové, 2008; Kim & Kim, 2013; Kim., 2010; Marginson, 2011; Selvaratnam, 1988). While Marginson (2011) suggests that this does not exist, others claim that Asian has developed a hybrid system of higher learning (Jung, 2018; Kim & Kim, 2013; Lingard, 2018; Sen, 2019). According to Sen (2019), hybrid systems are defined by *“... the sustainability of externally imposed ideas and values, and for the seriousness of the government’s embrace of these ideas and values. ... the embrace of new/foreign-imposed principles is pulled back by the continuity and persistence of the legacies and practices of the previous regimes.”* (p. 11).

Nonetheless, all of the listed countries represent a ‘Western’ education model has profoundly influenced local systems across the globe since the end of Second World War, most recently in South-East Asia (Altbach, 2009). How each nation follows an indigenous process of forming such a hybrid model varies depending on specific local histories and cultures. This study assumes that contemporary higher education in Cambodia is a hybrid of Western and Asian values and that each national culture is unique. It explores how certain traditional Asian values have interacted with Western values in the case of Cambodia.

Asian higher education has been highly influenced by Western values and structures, specifically Anglo-Saxon culture. However, its indigenous processes differ. Yang (2013) suggests that the fundamental failure of non-

Western societies to effectively build local higher education systems stems from a history of colonialism and the global diffusion of the European university model. Modern universities are Western-oriented and lack links to indigenous academic traditions. Jung (2018) notes that the higher education model in Asia is a hybrid model. Interactions between global powers and the advancement of multifaceted ideas and culture have since caused this model in each national context to become more diversified. A range of higher education reforms have emerged with respect to governance, methodologies, research culture, and financing.

The hybrid process is culturally perceived to have a strong foundation that *'has established its history, values, process and goals'* (Tierney (1988) under many cultural influences at the departmental, institutional, and national levels. Tierney (1988) emphasizes that one can succeed in understanding the multidimensional interaction of cultural influences in the development of higher education systems, only after learning how shared goals have also interacted. Hence, it is essential to conceptualize higher education systems in the South East Asian context within a framework of local knowledge about practices of developing higher education policies before external influences can be explored.

Several external powers have influenced higher education in Cambodia through both colonization and overseas development assistance (Ayres, 2000; Sam, Zain, & Jamil, 2012). This includes influence from socialist bloc states (i.e. The Soviet Union, Vietnam, and China), French colonial power, and the dominant US educational model (Ayres, 2000). The level of outside influence has differed over time, which makes it difficult to conceive a simple dichotomy

of external and Cambodian values. For instance, Chinese Confucianism, emphasizing decision-making by seniors, human relationships, and respect for authority, remains a strong cultural influence (Jung, 2018). On the other hand, since the 1950s, Cambodian higher education has experienced dramatic growth, as well as decline and revival from a *'ground zero'* in the 1980s.

The Cambodian government has set a Higher Education Vision 2030 and Roadmap 2017-2030 to inform the development of policies and practices for higher education. These include a vision *'to develop human resources with excellent knowledge, skills and moral values'*; and a mission *'to develop an accessible higher education system that is diverse, internationally-recognized, and conducive to teaching, learning, and research'*; as well as goals regarding *'quality and relevance, access and equity, internationalization and recognition, and governance and finance'*.

This paper identifies the historical influences on Cambodian higher education based on traditional Angkorean values, as well as overview of major, contemporary Western influences. It will elaborate how the Cambodian higher learning system has historically evolved via the interaction of national traditions with external influences. This highlights that the inclusion of the cultural dimensions of traditional socio-cultural values in Asian and Cambodian history is crucial for higher learning reform for the nation. It may be able to respond to the commercial exploitation of educational businesses and hinder potentially problematic practices.

Research Methodology

This research utilizes a critical literature review, adopting a post-positivist epistemology meaning that the research is based on qualitative analysis as a research methodology, supported by secondary data. Based on an interpretivist paradigm, the author responds to various journal articles and policy documents. The paper is divided into five main sections. The first describes the development of the higher education system in Cambodia from a historical perspective. The second analyzes the educational value of Angkorean heritage, Asian values and debates about their impact on higher education in Cambodia. The third illustrates the similarities and differences between Western and Cambodian higher education models. The fourth presents the current impacts of the adoption of Western higher education models on Asian universities. Finally, the paper discusses the indigenous response of the Cambodian higher education sector to Western higher policies and practices at institutional and individual levels.

Results and Findings

Higher learning development in Cambodia: a historical perspective

Cambodian higher education was influenced early by Indian and Chinese merchants and missionaries, who traded goods along the Mekong River. This occurred via the means of education or the dissemination of religion (i.e. Brahma or Hindu) (Sam et al., 2012). This historical anecdote of external influence on the education system is common with Africa, where Grigorenko (2007) noted:

“Early accounts of the first direct educational influences from outside can be traced back to religious missionaries ... Various religious missions were the first to establish and support schools and initiate and promote studies of indigenous languages.” (p. 167).

The country first established two universities during the Angkorean period in the 12th century, with 18 individual doctoral degrees for cultural and religious intellectuals, and around 740 university teachers, heavily based on the foundations of Brahma and Buddhism (Sam et al., 2012). In the presence of the Angkor Wat temple heritage, Cambodia is believed to have built a unique, sophisticated tradition, values, norms, and culture. This period marked the peak of the Angkorean era, where the Cambodian (Khmer) educational system developed rapidly and attracted students from neighboring countries. Under the wise national leadership of Indradevy, the queen of King Jayavarman VII (1181-1220), two universities were established, located in Preah Khan temple (Vat Cheysrey) and Taprohm temple (Raja Vihear), respectively. During 12th century, Cambodia was a most powerful kingdom within the Southeast Asian region, comprising 1081 ancient temples nationwide (Sam et al., 2012).

By the 15th century, the glorious period of Angkor had declined dramatically. Some scholars claimed that ineffective adaption to prolonged droughts in mainland Southeast Asia during transition from the Medieval Climate Anomaly to the Little Ice Age; along with social vulnerabilities, led to the this failure (Evans et al., 2007). According to Duggan (1996), Cambodian higher learning institutions were closed at this time due to civil wars and

invasions from neighboring countries. Duggan (1996) notes that *“Cambodia has experienced a troubled history since the demise of the Khmer Empire. It is not a well-known history when compared with Western knowledge of Cambodia’s neighbors. Indeed, the image of Cambodia in Western thought roughly coincides with French intervention in Khmer affairs in the nineteenth century”* (p. 363). During the 17th century, the French invaded Cambodia as well as other neighboring countries. Under colonization (1863-1953), the French tried to transform the traditional Cambodian education system into a modern or Western form by importing the French education model. Nascent archaeologists and researchers claim that Cambodian culture reached a sophisticated level during the Angkor era and became an empire in Asia that disseminated influence among neighboring nations (Sam et al., 2012).

The post-colonial period after 1953, demonstrated the lasting influence of the French system of education administration, largely due to the existing bureaucrats, administrators and human resources that were either educated in France, or within the French colony (Ayres, 2000; Sen, 2019). Unfortunately, the nation, a site for ideological competition between socialist bloc states and those from the West, fell into the Cold War in 1970, when the Prince with ruling power was defeated in coup-d’état by Western-backed opposition. During this period, the national higher education system was heavily destroyed as part of the Khmer Rouge regime between 1975 and 1979, when all forms of educational institutions were closed.

Between 1980 and 1996, Cambodia went through a rehabilitation stage and the higher education system was rehabilitated under the support of communist bloc countries, such as Russia, Vietnam and Eastern Europe

(Kitamura et al., 2016). The implementation of a higher education sector in Cambodia during this rehabilitation stage was not prioritized and higher education institutions (HEIs) were left to operate with poor resources, in terms of both infrastructure and human capacity. Foreign donors implemented scholarship schemes for sending students to study in communist bloc states such as Russia, Vietnam, and China. Since this period, education and human resource development has become a dominant discourse in the development agendas of donors and development partners, notably the United Nations Development Program (UNDP) (Duggan, 1997).

The rehabilitation period attracted greater external influence from socialist bloc countries, as well as the French administrative model. In contrast, Chinese influence focused more on social values and norm, and the orientation of leadership in Cambodia (Ayres, 2000). This orientation has contributed strongly to a culture of educational leadership and governance, specifically following the Confucian tradition of the 19th century. For instance, both French administration and leadership, as well as Chinese Confucianism, with its emphasis on seniority-dominated decision-making, human relationships, and respect for authority, remain as strong cultural influences.

The privatization of Cambodian higher education emerged in 1997, when the first private university, Norton, was established (Sen et al., 2013). By 2019, there were 125 higher education institutions (77 private) in Cambodia (MoEYS, 2019, p. 40). Between this time and the 2016/17 academic year of 2016-2017, university enrolments increased by over seventeen times, from 10,000 to 174,142 students (Sen, 2017). While Cambodian universities have adopted a neoliberal ideology, individual rights and social reform have been

compromised by an emphasis on free-market competition. Chealy (2009) and Sen (2012) claim that several issues continue to affect the Cambodian higher education sector, including a lack of coordinated governance, with both communist versus pro-Western ideologies, as well as a shortage of professional staff.

The debates with respect to Angkorean heritage and Asian values

According to Barr (2000), the conceptualization of ‘Asian values’ stands on three dimensions: paternalism, authoritarianism, and elitism. These dimensions are emphasized through two key features: family-focused communitarianism and state-focused communitarianism. Barr (2000) argues that ‘*familial communitarianism*’, which can be identified in the semi-democracies of Singapore and Malaysia, emphasizes the important role of the family, as a priority source of social good and authority; while ‘*republican communitarianism*’ is a form of totalitarianism that gives sole power to the state.

There have been debates on whether ‘Asian values’ exist, and if they have contributed to the development of the contemporary Asian higher education sector. Altbach (1989) notes that there is not an Asian academic style. However, an Asian country such as China has unique, long-term traditions with respect to higher education (Yang, 2013). Cambodia has an even longer history since the Angkorean empire, with its blooming education period (Sam et al., 2012). The Confucian model, embedded in Asian higher education, may be observed through several institutional structures including: a strong national structure, large private capital investment, and high

competition through strict assessment structures (Marginson, 2011). While it is undeniable that Asian higher education has been strongly influenced by Western culture and development models, differences in cultural perspectives remain, especially with respect to network-based for jobs among senior academics (Jung, 2018).

According to Kim (2010), one can identify Asian values as *'cultural orientations, beliefs, norms, or attitudes, unique to the Asian region that form these bases of their political, economic, and cultural institutions and processes'* (pp. 317-318). Several heritages such as magnificent temples, landscapes, and all forms of styles and architecture remain indispensable pieces of evidence as pride in Asian values, existing at a different level of society and in different regions. One example of these values is the Confucian tradition Asian people often maintain in daily life and work. Confucian philosophy is well-known around Asian countries for preaching the conduct focused on an upright life, which has powerful relevance to norms and values within contemporary society (Kim, 2010). In a reciprocal way, the immediate consequences of hardship in life may occur once one breaks norms and values set within this philosophy.

Many Asian people believe the philosophy of Confucius is upright dharma (i.e. thought for enlightenment pathways). Asian social lifestyles, including, social etiquette, academic outcomes, and learning approaches are influenced by Confucian philosophical beliefs (Park, 2011). Similarly, Kim (2012) noted that Asians have unique traditions, culture, and a way of life, which are different to other global cultures. According to Goh (1994), Asian values have *'a sense of community and nationhood, a disciplined and*

hardworking people, strong moral values and family ties' (p. 417). Collectivist values have also been prominent within Asian society. As cited in Jung (2018), Russell and Shin (2006) describe the two key characteristics of Asian values as *'respect for hierarchy and concern for collective well-being'* (p. 174).

Throughout the period of economic growth in the 1990s, core Asian values such as familism, communalism, authority orientation, a strong work ethic, and education were largely well-identified. Values such as discipline in the workplace, saving, being responsible, having social support, giving priority to collective goals, and family-centred attitudes are key values in Asian society (Kim., 2010). Thus, most Asian people respect and practice Buddhist prescriptions together with the philosophy of Confucius in their daily life, as they consider that this is the pathway to harmony and a bright future in life.

Several debates have emerged with respect to the Asian higher learning model. The main theme for this debate is whether Asia has pioneered a higher education model. Altbach (1989) maintains there is no academic development model among Asian nations, rather a range of modernization reforms, under the influence of the Western higher education models. Asian countries, however, are perceived to have their traditions and a unique culture of higher education development. For instance, Yang (2013) argues that Asian nations have initiated long-held traditions of higher learning, which are different from those in the West. They are unique with respect to higher learning being orientated towards local culture, society, and a natural definition of humans; as well as human relationships amongst the population.

While the debate remains open, Yang (2013) notes that the most successful Western export throughout the world is the idea of a modern

university. The distinction of 'East' and 'West' has been used as a value for judgement with respect to the typology of higher education models. De Barry and Chaffee (1982) suggest that this distinction has led to a differentiation between Asian or Western higher education models being typecast as '*Asian backwardness and Western superiority*'. This convergence of values within Eastern and Western education models has resulted from past colonial experiences and the recent influence of globalization, which has transformed the world system in a range of transactions, such as institutional governance, curricula, academic culture, and English language use (Altbach, 1989). These transactions include economic changes towards global market competition and the internationalization, or global benchmarking of education standards (Han & Jarvis, 2013).

The adoption of practices from the Western higher education model are intertwined with an existing variety of local educational traditions, values, cultures, and societies. This is obvious when considering powerful Asian economies, including Japan, Korea, Singapore, and Taiwan; higher middle-income countries, including Malaysia, Indonesia, Thailand, and the Philippines; and lower-middle-income nations, including Cambodia, Laos, Myanmar, and Vietnam (CLMV); and how they grown with respect to fundamentally different contexts. Despite common priorities, with respect to conforming with international trends; namely, internationalization, CLMV nations have not produced the activities and output that constitute a strategy for successful educational quality reforms (Hill et al., 2019).

Major challenges facing CLMV countries attempting to move towards strategic reform and modernization may be identified through unique

authentic differences from the Western world, namely geographical context, history, culture, and human capacity. Hill et al. (2019) notes that *“systems and regulatory structures, traditionally designed for national activity, are ill-prepared to support international engagement. Key examples of this include a lack of credit transfer systems and a lack of resources and infrastructure”* (p. 11). Duggan (1996) also notes that *“Cambodia has experienced a troubled history since the demise of the Khmer Empire. It is not a well-known history when compared with Western knowledge of Cambodia’s neighbors. Indeed, the image of Cambodia in Western thought roughly coincides with French intervention in Khmer affairs in the nineteenth century.”* (p. 363). Therefore, the higher education system in these nations is rooted and dependent on history, socio-cultural aspects, as well as political and economic development pathways.

In this context, we may ask whether a dichotomy exists between Asian and Western values in Cambodian higher education. As higher learning first occurred in Cambodia in the glorious period of the Angkor era in the 12th century (Sam et al., 2012), Cambodia must have had a unique traditionally-oriented higher education model. Modern higher education was then introduced into Cambodia during the French colonial period between 1863 and 1953. The significant distinction between the importation of the French model and the Western model of higher education is that the former was based on suppression through colonization, and the latter was systematically constructed through rehabilitation, under the guise of various ideologies: globalization, aid dependency, and neo-liberalism.

Higher education models from the West have now reached the periphery of South-East Asia. Altbach (2009) claims that these educational models have taken root in all Asian universities. These countries now find themselves without their own university models, nor Asian academic models (Altbach & Selvaratnam, 2012). This has resulted from the influence of Western industrialized economies and curriculum models. The process of forming such hybrid models inevitably reflects an interaction between the external and internal interests as *“this process not only stresses greater interaction with external or Western values, but is also deeply concerned with the traditional values, institutions, and practices”* (Chan et al., 2017, p. 1805).

The root of these hybrid models has been formed through a history of colonization (Arnove, 2008). Complex historical struggles that arose from the dynamics and tensions between hegemonic global models and the local contexts of political, economic, and socio-cultural needs have formed a new hybrid model of education amongst periphery nations. Such interaction has grown rapidly, as a result of Western success in transmitting neoliberal ideologies and mass higher education systems through global marketization, by which global agencies utilize powerful technological tools (Huang, 2007). Through a range of mechanisms, developing nations conform to structural adjustment policies and development assistance, through scholarship programs. Chan et al. (2017) notes that, *“hybridization does not take place naturally but is a painful and hesitant process as a result of social-cultural constraints and structures”* (p. 1806).

Countries in Asia, including developing economies like Cambodia, have managed to enhance autonomy in their university systems to incorporate

fundamental aspects of local needs and realities. Shin et al. (2016) claim that despite substantial evidence of influence related to the Western models, Confucian tradition is seen as commonly shared amongst Asian higher education systems. Likewise, the interaction amongst Asian cultural heritage, Western dominance, economic development, and the emergence of globalization has played a dynamic role in shaping East Asian higher learning models (Neubauer et al., 2013). Therefore, contemporary higher education models in Asia have been formed through negotiation for space and elements, by which models have evolved within the local contexts, despite the dominant influence from the West.

Given the contemporary hegemonic power from Western higher education models, educational policy formation in developing nations, specifically Cambodia, often reflects an exclusive Western ideology. Bhabha (2012) maintains that the notion of a hybrid model is the product of the struggle and resistance that has occurred between the powerful colony and local culture. Under globalization, these processes have become imperfect because of politics and the complex conditions that lie within the concept of hybrid models (Rizvi, Lingard, & Lavia, 2006). While higher education models in Asian nations have been recognized as substantially influenced by the West, they have also been intertwined with local needs and the implementation of local policies and practices.

Cambodian and Western higher education models

The organization and structure of the Cambodian higher education system has some similarities with the Western model, particularly in terms of

the policy agenda focused on hardware. The level of government control in Cambodia is more pronounced in state universities than private ones. For state institutions, it is the responsibilities of government, represented by each ministry to supply staff, salaries, and basic operation fees, while the universities charge fees through private programs. Another similarity is the neo-liberal agenda, where universities are left to their own devices to generate income to support their operation on a competitive basis in terms of attracting students and private funding (Sen, 2019; Un, Boomsma, & Sok, 2018). Other similarities include the types of institutions and the system of an academic year. Additionally, institutional structures, including vision and mission statements, departmental structures, the division of disciplines, facilities, governance, management and administration are similar to those found in the higher learning model of the West (Sen, 2019). These similarities include the level of government control, the type of institutions, and the systems of privatization and corporatization.

Differences emerge in the structure of Cambodian higher education system. The system is complex and governed discretely by parent ministries, under the central power of the Royal Cambodian Government. Current there are 16 parent ministries that supervise universities, none of which have the sole authority to supervise the 125 existing HEIs, 48 of which are public universities (MoEYS, 2019, p. 40). According to Sen (2012), a number of ministries in Cambodia are authorized to run and operate the HEIs, due to the relevance of their expertise in relation to the curriculum and potential for their human resources and facilities to contribute towards educational programs. Nonetheless, higher education policy formation and practice is initiated,

supervised, and directed by the MoEYS. Further, Cambodian universities are heavily influenced by the political economy of structural adjustment, led by overseas development assistance. The dependence of each Ministry on foreign aid tends towards corporate worldviews amongst policy elite and capitalist stakeholders. Teaching curricula, as well as instructional and research methods, show greater differences rather than similarities. For example, about 90% of lecturers have never published an academic paper and there tends to be a “*teaching-oriented*” rather than “*research-oriented*” culture (Chen et al., 2007).

The biggest difference of all is the existence of a network-based academic job market, where unqualified and unprofessional investors claim power and authority to own, govern, and direct universities, particularly in the case of private institutions. Un et al. (2018) noted that “*the rise of corporate culture at public universities: the institutional focus lies on managerialism to achieve and maintain efficiency and effectiveness rather than promoting academic intellectual inquiry and an academic culture of collegiality and esprit de corps.*” (p. 6). Through this practice, the long-term needs of academic society, social justice and social-democracy have been heavily undermined. Powerful university owners exercise power to recruit or expel academic professionals on the basis of profit maximization and enrolment targets, rather than the public good.

The overall character of academic culture in Cambodia is oriented towards academic networks. Chen et al., (2007) mentions that teaching quality in Cambodia is poor in terms of qualifications, teaching methods, and teaching and research experience. There is limited support for university

hardware and software, or the funding of buildings and human resources in the government budget. This occurs even though the university system as a whole has been reformed towards a governance structure of benchmarks, oriented towards the modern university system of the West. Cambodian higher education is deficient in terms of both academic and non-academic support services. The sector is financed at *'only 0.05 per cent of GDP'* (the World Bank, 2012, cited in (Sam et al., 2012, p. 121).

Overall, academic culture is quite different in Cambodia, compared to Western universities. It is quite common to identify a culture of work that emphasizes seniority, authority, interpersonal relationships and collective well-being within Cambodian universities. While cultural knowledge takes longer to change, scientific knowledge can change faster without requiring time to be embedded into an existing culture (Schelkle, 2000). As Western ideas have not been embedded into the local understandings and practices, problems arise when integrating Western and local ideas within Asian universities.

Impacts of Western higher learning models on Cambodian universities

The West has influenced Asian higher education models by forcing them to conform to standards of massification, privatization, accountable governance structures, internationalization, and benchmarks of world-class universities (Shin and Harman 2009). While the university development model of the West has increased rapidly in influence, the Asian higher learning model faces several reform challenges. The governance structure within Asian

nations has evolved to one of '*decentralized centralization*' as a result of decisions made at the national level, despite policies that transfer the administration of these functions to lower levels (Sensenig, 2011). It is described as a form of governance, where the government allocates university funding through evaluation-based budgets (Sensenig, 2011).

Moreover, internationalization has been increasingly promoted in the Asian higher education sector. Implications with respect to global university rankings has persuaded Asian universities to conform a set of criteria, which implies the adoption of a particular university model, especially in terms of curriculum, faculty management and leadership styles. However, it needs to be questioned whether this contributes to national development pathways, namely for the benefit of society at large. Shin and Harman (2009) note that the current goals of the global internationalization of higher education is led by certain interest groups, established by the OECD under a benchmarking system of incentives and sanctions. Under the influence of globalization, however, most universities in developing economies, reflect a situation of having low capacity, which is framed as needing to catch up to a neoliberal agenda such as the new PMS from the West.

From a social justice perspective, the university system has been largely undermined by corporate worldviews held by higher education policy elites and investors. In this regard, academic freedom, quality, and the true value of education value have been largely ignored, in preference for free-market competition and profit-maximization (Lingard, 2018). For instance, the emergence and rapid expansion of a quality benchmark-setting framework to align universities with regional and global standards based on OECD

longitudinal data analyzing ten countries. Announcing Japan and South Korea as representative of Asia, threatens the social justice and well-being of individuals in society at large (Shin & Harman, 2009). Lingard (2018) notes that the emergence of actors in the OECD Program for International Student Assessment (PISA) project as a new non-state policy actor. Educational business networks, such as the British owned publication and assessment network, Pearson Education, have undermined the essence of social democracy and justice across the international community.

Therefore, how the higher education policy reform agenda is adopted at the local and global scale, in terms of promoting the true value of education and knowledge creation for enhancing social justice, becomes of increasing importance for addressing widespread social problems. Emerging academic problems include an increase in authoritarianism, racism, environmental degradation, and other policy dilemmas. That is bringing universities towards a corporate worldview will tend to expand the gap between economic growth and well-being for all individuals (Singh, Gray, Hall, & Downey, 2018). An emphasis on the role of the private sector and the new public management principle is intended to prepare the Cambodian higher education system to serve dominant market interests. Un et al. (2018) noted that *“in Cambodia, this neo-liberal trend has fused with the politicization of higher education. Both commercialization and politicization prevent universities from properly functioning as a public sphere”* (p. 6). These influences from Western higher education models have also tended to gear the Cambodian higher education model towards privatization, international competitiveness, student choice, and producing low-quality skills within graduates.

Under neoliberalism, education practices are driven by the market, with a focus on competition and individualism. This supports and encourages national and international standardized, high-stakes testing, i.e. ‘*best practices*’ (Noblit & Pink, 2016). The Cambodian government has reformed higher education policies to conform to international standards aimed at strengthening efficiency and quality. Several policies have been reformed, including by the government cabinet and the Ministry of Education, namely the National Strategic Development Plan (NSDP) (RGC, 2014a); the Higher Education Vision 2030; and the development of a Cambodia human resource (MoEYS, 2014a, 2014b). These policies have been reformed in response to demands from the labour market, and the agenda of development partners. A range of policies related to specifically science, technology, engineering, creative arts and mathematics (STEAM) subjects have been developed as a strategy towards strengthening the role of universities in respond to the needs for development through regional and global integration (MoEYS, 2014a, 2014c; RGC, 2014a, 2015).

From the perspective of the education system, Cambodia has made a remarkable improvement since the Khmer Rouge regime (1975-1979). Such achievements include, 1) the existing modern university system and the establishment of quality assurance body; 2) a five-year budget to promote research culture and a policy on Research Development in the Education Sector; and 3) a Master Plan for research development and several key Policies for higher education development, such as the Higher Education Vision 2030.

From a cultural perspective, there is a huge contrast in terms of academic culture amongst instructional staff and the evaluation of

performance. While universities in the West focus on research publications, research culture is almost ignored within Cambodian universities. In the Cambodian higher education system, a *'teaching-oriented'* culture dominates over a *'research-orientation'*. Of note, 90% of lecturers at Cambodian universities have never published an academic paper (Chen et al., 2007). While the neoliberal agenda within the Cambodian university system has resulted in some positive changes, the ideology has been strongly criticized in terms of the deterioration of essential higher education values such as, academic freedom, social justice and social democracy and reducing inequality (Singh et al., 2018).

A shift towards neoliberalism in the higher education sector of many Northeast Asian countries has brought about radical changes in five key dimensions including the multi-faceted retreat of the state, enhanced roles of private investment and entrepreneurialism within universities, enhanced international competition and internationalization, application and acceptance of neoliberal ideologies, and a shift to a curriculum focus. Several issues remain within higher education, with respect to responding to present social, economic, political, and cultural needs at national, regional, and global levels. These include a plurality of authorities, regulatory regimes, inadequate capacity of actors, and a skills mismatch (Sen et al., 2013). As education is believed to play an important role in promoting the social, cultural, political, and economic development (Chen et al., 2007), current neo-liberalization policies in Cambodia may have positively impacted some of these aspects in the short-term. However, the nation requires a more critical development

direction, as the share of economic growth, and welfare distribution has become more inequitable.

The indigenous response to Western higher education trends

In response to growing complexity, the Royal Government of Cambodia has undertaken numerous efforts to reform and strengthen the higher education system through different institutions such as the Accreditation Committee of Cambodia; Educational Policymaker Team; and the National Strategic Development Plan 2014-2018 (RGC, 2014b). The Education Law has also been more rigorously enforced to balance the quality and quantity of education providers (Chealy, 2009), as well as matching skills development to national policies (MoEYS, 2014a; RGC, 2012, 2013). However, problems in the Cambodian university systems prevail (Sen et al., 2013). Since a wave of privatization in the mid-1990s, the number of Cambodian universities has increased almost tenfold, from less than 16 to 125 institutions between 1997 and 2019 (MoEYS, 2019). Other accomplishments include new policies, such as the Cambodia Higher Education Vision 2030, and Industry Development Policy 2015-2025; the emergence of research culture; the foundation of a capacity for planning, monitoring, capacity building; and growing regional and international cooperation within university networks.

Overall, the growing number of university graduates has responded as expected via the NPM framework of neo-liberalization. Meanwhile, the rapid growth in the number of universities reflects the dependence of the Cambodian higher education sector on expansion, given that the current capacity for improving quality is quite insufficient (Cambodia HRINC, 2011).

This tends to lead the higher education sector into neglecting the long-term needs of the nation, as well as weakening the system as a whole (Chealy, 2009). There is a clear need for higher education to be restructured, with respect to a research culture, quality teaching, and the well-being of all intellectuals and students.

Conclusion

This article reveals that the Cambodian higher education system has been shaped by the integration of external influences with national traditions. Historical cultural values and educational traditions have been integrated within a modern educational system. The French higher education model first shaped this hybrid model, which was formed as a result of the dominance of French colonization. Current Western values influence higher education in Cambodia through the conflict between new policies, local practices and socio-cultural contexts. Many aspects of higher education in Cambodia have already changed as a result of regional and global benchmarks. The Cambodian system has made a remarkable progress, after essentially starting from scratch in the 1980s. From a long-term social development perspective, the university system has been undermined by corporate worldviews amongst elites and investors in the sector. From a cultural perspective, there is a huge contrast between the academic culture of institutional leaders, practitioners, and instructional staff, regarding their professional capacity and mindset influenced by the colonial and civil war history.

The dichotomy between local historical, socio-cultural, and political contexts are less significant with respect to education policy for the core

development components of universities. In this case, policy reform generally focuses on academic programs, research and consultancy, post-graduate scholarships, research, instruction and learning, management, human resources management, finance, infrastructure and facilities, student services and development (Hussin & Ismail, 2009). This paper focuses on the cultural dimensions of both Asian and Cambodian history, traditional values, and socio-cultural aspects. Inclusion of this cultural dimension may enhance the effectiveness of education policy reforms.

It is essential that the development of higher learning policy and practices incorporates local cultural elements. These have been embedded into the way of life of citizens over centuries and exist in the form of religious beliefs, values, norms, and lifestyles, as well as the local environment and infrastructure. The idea promoted is that modernizing higher learning systems cannot transform the indigenous models but they instead form hybrid models. This process of hybridization cannot ignore local socio-cultural conditions when new policies are implemented. It is important to consider what contribution local values contribute to teaching, research and social engagement in higher education. Awareness of traditional values will assist in the formation of regional models and collaboration, with respect to higher education reform in post-conflict states moving forward.

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Brief Biography

Keun IM is a higher education researcher and practitioner. He is a professional teacher trainer at the National Institute of Education (NIE) in Cambodia. He lectures at many universities in Cambodia and holds a MA in Education and Human Resource Development from Nagoya University. His research interests include higher education policy and planning for HEIs, and political theory related to education policy development. He has published research on institutional management, dropout rates among students, and the efficiency of educational processes. He has also acted as a strategic consultant to the IELTS sector.

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Capacity building of secondary school principals: A case study of the School Leadership Upgrading Program (2019-2020) at the Royal University of Phnom Penh (RUPP)

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សារគន្លឹះ:

- ✓ ដើម្បីរៀបចំកម្មវិធីសិក្សាវិក្រឹត្យការលើការលើកកម្ពស់គុណវុឌ្ឍិភាពជាអ្នកដឹកនាំ សម្រាប់នាយកសាលានៅកម្ពុជា មហាវិទ្យាល័យអប់រំនៃសាកលវិទ្យាល័យភូមិន្ទភ្នំពេញបានបង្កើតកម្មវិធីបណ្តុះបណ្តាលមួយប្រកបដោយនវានុវត្តិដែលមានស្ថេរភាព ចនាភាព ច្បាស់លាស់ ដោយយកទិន្នន័យដែលបានពីសិក្ខាកាមជានាយកសាលា សមត្ថភាព និងការកិច្ចបច្ចុប្បន្នរបស់ពួកគាត់ជាមូលដ្ឋាននៃការចាប់ផ្តើម។
- ✓ ក្នុងការបណ្តុះបណ្តាលការគ្រប់គ្រងសាលារៀន ស្វ័យភាពនិងភាពស្ម័គ្រចិត្តក្នុងការរៀបចំនិងការអនុវត្តកម្មវិធីបណ្តុះបណ្តាលព្រមទាំងការរៀនដោយសម្របតាមភាពជាក់ស្តែងរបស់អ្នកសិក្សាបាននាំមកនូវការផ្លាស់ប្តូរជាវិជ្ជមានដល់ការសិក្សារបស់សិក្ខាកាម។

- ✓ កម្មវិធីសិក្សាការបណ្តុះបណ្តាលនេះគួរទទួលបាននូវធាតុចូលនិង ព័ត៌មានត្រឡប់ជាប្រចាំក្នុងទម្រង់ជាកម្មវិធីរស់រវើកមួយដែលមាន ភាពប្រទាក់ក្រឡាគ្នា ងាយបត់បែននិងឆ្លើយតបតាមសភាពជាក់ស្តែង ហើយទាន់សម័យទៀតផង។
- ✓ ការផ្សារភ្ជាប់គ្នាយ៉ាងសកម្មនិងជាប្រចាំរវាងគ្រូឧទ្ទេសនិងអ្នកសិក្សាកាម ដោយពុំខ្លាចមានការខុសឆ្គងបាននាំមកនូវការអនុវត្តប្រកបដោយ នវានុវត្តន៍ និងគប្បីលើកកម្ពស់សម្រាប់កម្មវិធីបណ្តុះបណ្តាលវិក្រឹត្យការ ដែលមានលក្ខណៈស្រដៀងគ្នានឹងកម្មវិធីនេះ។
- ✓ ការបន្ស៊ីទៅនឹងការអនុវត្តជាក់ស្តែងនៅតាមសាលារៀនមានសារៈ សំខាន់ក្នុងការបង្កើតចំណេះដឹងថ្មីសម្រាប់ការសិក្សា និងសម្រាប់ ធ្វើឱ្យកម្មវិធីបណ្តុះបណ្តាលមានភាពប្រទាក់ក្រឡាគ្នាជានិច្ច។

Key Messages

- ✓ To design an in-service leadership upgrading curriculum for Cambodian school principals, the Faculty of Education, at the Royal University of Phnom Penh developed an innovative training program, with clear indicators, beginning with principal trainees as individuals and their existing competencies and responsibilities as starting points.
- ✓ In school-based management training, autonomy and expertise in designing and implementing the program, as well as the use of adaptive learning principles has led to positive changes for the learning practice of trainees.
- ✓ The training curriculum should receive continuous input and feedback in the form of a living program to make it relevant, adaptive, responsive, and up-to-date.

- ✓ Continuous and active engagement between trainers and trainees, without fear of mistakes is shown to lead to innovation and should be promoted for in-service training programs of a similar nature.
- ✓ Connecting to grounded practices from the field is essential in creating knowledge for learning and keeping the training curriculum relevant

Keywords: Leadership Upgrading Program (LUP), Faculty of Education, progressive data driven curriculum, living training program, Secondary Education Improvement Project (SEIP)

Background

Over the past 20 years, Cambodia has invested much effort and resources into building human resources. According to Hang-Chuon (2017), although the quantity and quality of human resource in the country has improved, the education sector needs better commitment to improving quality. Education reform for quality improvement is outlined in the Education Strategic Plan (2014-2018) focused on school-based management. This is in line with the Rectangular Strategy IV of the Royal Government of Cambodia (RGoC) (Hang-Chuon, 2017a). Keng (2009) discusses the insufficient capacity of human resources, with respect to the equity and quality of basic education in Cambodia. This is still true to a large extent. Chet (2009) also highlights how basic education issues play out in higher education.

Recently, linked to significant efforts from the RGoC, student enrolment in basic education has increased significantly. For instance, it improved from 83.8% in 1992 to 98.4% in 2015, for primary school students and from 31.9% in 2009 to 51.5% in 2015 for lower secondary schools (World Bank, 2019). Hang-Chuon (2017) applauds the achievement of an overall student

enrolment of 97.0%, although he notes that student completion at each level remains a concern. The Minister of the MoEYS outlines how a nationwide assessment results for students of Mathematics and Khmer language indicate that around 40% of students assessed in Grade 3 during 2016 and Grade 6 in 2015 performed below standards set in the curriculum.

Noticeable issues for lower secondary education fall into at least four main categories — student performance, teacher performance, principal performance, and community engagement (MoEYS, 2018). Existing studies confirm that students still perform very poorly in reading and simple calculation. It is generally known that Cambodian schools need more relevant curricula, sufficiently trained teachers, and more resources to improve school performance (OECD, n.d.). Soft skills development, including critical thinking, peer learning, small group discussions and plenary consultations are currently not used as learning modes in Cambodia. To do so, would provide an opportunity to take action on promoting thinking skills, creativity and innovation (Chhem, cited in Barrett, 2017).

Similarly, teacher capacity and performance still required a lot of improvement, if students are to realize their full potential in line with regional standards (OECD, n.d.; Barrett, 2017). In 2016, a study conducted by the MoEYS and World Bank found that 70% of schools sampled had inadequate supplies, as well as under-qualified teachers (World Bank, 2019). Teachers were not engaged in regular continuous professional development or in-service training to reskill or upskill, after graduating from a Teacher Education degree (MoEYS 2019). In addition, teachers still follow traditional teaching

approaches, except for those trained in the latest methods for use in New Generation Schools (Donaher, 2020).

Before the capacity of teachers is strengthened via a leadership scheme, collaboration between the community and school needs improvement (MoEYS 2018). Schools in Cambodia still have not yet established an environment in which parents, villagers and local authorities work together to support student learning and the successful functioning of a school (MoEYS 2018). The sense of inclusiveness experienced by students in Cambodia is limited, let alone the engagement of families and the community (MoEYS 2018).

Capacity building for leadership skills among school principals is considered to be an emerging issue in Cambodia. School success is challenging to achieve without effective school leaders. Positive changes in schools are made by “*great leaders*”, who are able to manage issues arising from teachers, students, parents, and other involved stakeholders (Bartoletti & Connelly, 2013). When this occurs, significant change can be observed in both teacher (Bredeson & Johansson 2000) and student achievements (Hallinger & Heck, 1996; The Wallace Foundation, 2011). The performance of school leaders, teachers, and students can reflect on the success of a school. Student achievement is the most important criteria to look at when a school assess its success. Both Hallinger & Heck (1996) and Lambersky (2016) agree that school leadership influences student learning. For instance, it is meaningless to have a clean school environment with modern facilities if the learning achievements of students is below average. Thus, a major challenge for school leaders is to consider how to support slow learners to study at the right level.

Although school leaders can never achieve school success alone, they need to lead and collaborate with other relevant stakeholders to reach greater heights. According to Leithwood & Seashore-Louis (2012), educators need to create synergy between parents, teachers, and policy makers; while those in leadership positions need to be well positioned to lead this synergy. Capacity building for school principals is required in terms of pre-service and in-service training to promote more effective leadership and involvement from teachers. This is likely to result in effective school management as part of a proper school development plan (Keng, 2009).

Senior officials at the MoEYS and World Bank in Cambodia agreed to implement the Secondary Education Improvement Project (SEIP) (World Bank, 2019) in response to these needs. A school-based management governance model has been piloted in 100 schools across the country as a result of the program. It is aimed at meeting minimum standards in lower secondary education in specific target areas, effective responses in emergency situations. One component of the project is improving lower secondary education outcomes across three sub-components: (1) strengthening school-based management, (2) upgrading teacher capacity, and (3) improving school facilities (MoEYS, 2017).

In 2018, the Royal University of Phnom Penh was provided with a grant to conduct school-based management training, through a Leadership Upgrading Program (LUP) as a component of the SEIP. After just one-year of operation, the training program has received positive feedback from trainees, the MoEYS, and the World Bank. Under this nation-wide project, 100 target schools have now developed a systematic way of address specific challenges

in meeting nine minimum standards embraced by the project. This policy paper showcases the learning experiences and challenges faced as part of delivering the school principal capacity building program, with respect to curriculum development. By showcasing these learning experiences, it is hoped that future training of similar nature will be conducted more effectively.

Research Methodology

This policy paper presents an analysis of an in-service program developed on the basis of critical reflection (Merzirow 1990, 1998) by the developers and implementers of a Leadership Upgrading Program (LUP) at the Royal University of Phnom Penh. It occurred after two years of program implementation, which was sufficient time to make meaning of the experience and learn from it. Merzirow (1990, p. 1) wrote that *“to make ‘meaning’ means to make sense of an experience, we make an interpretation of it. When we subsequently use this interpretation to guide decision-making or action, then making ‘meaning’ becomes ‘learning’”*. Merzirow (1998) defines reflection as looking back on experiences and using reasoning to achieve the best foreseeable consequence of an action. In this paper, an analysis was conducted based on internal evaluations, progress reports, expert discussions, workshops, and meetings among the project team at the Royal University of Phnom Penh and the World Bank.

The analysis includes feedback and personal discussion with students and lecturers in the program. The project team also used views and insights from observations made during field visits to schools, where students were

managing or teaching a program. Document analysis of the LUP training manual, LUP progress reports and SEIP progress reports were also conducted. The implementation of the training was critically compared against the original plan. The authors of this policy brief then made conclusions based on what Merzirow (1998) calls *“reasons to achieve the best foreseeable consequences of an action”*. By future action, the authors referred to how we would improve on the training outcomes for future cohorts of the LUP program based on the experiences over the first two years of implementation.

Results and Findings

Designing the LUP curriculum for leaders of twenty-first century schools

Based on current school and student needs, the LUP was designed to create leaders of twenty-first century schools in Cambodia. As stated in the LUP curriculum (MoEY, 2018a & RUPP, 2019), the program expects participating school leaders to be able to (1) bring global knowledge to the local context and national reform programs to actual implementation at the school level; (2) generate community ownership in school development and build trust in the school and teachers within communities; (3) be equipped with the knowledge, skills and attitudes to comprehensively lead, manage and implement school-based management to achieve school effectiveness standards; and (4) prepare youth to be the global citizens and human capital in the world of the knowledge economy.

The LUP was designed specifically for trainees who are currently working in school management teams at secondary schools nationwide. The key concept of developing the LUP curriculum was based on the MoEYS School

Principal Standards, ‘9 School Standards’ (Figure 1), and the actual situation within Cambodian schools that lead to achievable actions, rather than concepts or theories with a poor contextual fit. As illustrated in Table 1, the LUP includes at least five key competencies, including strategic thinking and innovation, instructional leadership, personal excellence, stakeholder engagement, and managerial leadership (MoEYS, 2017a).

Table 1. Leadership roles in selected school principal standards

School principal standards	Leadership roles
Strategic thinking and innovation	<ul style="list-style-type: none"> • Establish the strategic direction of the school • Make decisions • Lead change and innovation
Instructional leadership	<ul style="list-style-type: none"> • Lead curriculum implementation and improvement • Create a learner-centred environment • Supervise and evaluate teachers’ performance • Deliver and plan learning outcomes
Personal excellence	<ul style="list-style-type: none"> • Ensure personal effectiveness • Act on challenges and possibilities • Pursue continuous professional development
Stakeholder engagement	<ul style="list-style-type: none"> • Promote shared responsibility for school improvement • Manage education alliances and networks • Sustain collaborative relationship with stakeholders
Managerial leadership	<ul style="list-style-type: none"> • Manage school resources and systems • Manage staff performance • Manage sustainable school programs and projects

Source: Adapted from MoEYS, 2017a and 2018

The co-development of the LUP curriculum by the MoEYS SEIP team, World Bank representatives, and the Faculty of Education at RUPP helped to develop a practical and impactful curriculum. It provides the type of innovative curriculum design that promotes active learning, self-learning by doing, and contextual learning. It is a hybrid learning approach that also uses result-based learning. In the other words, trainees are required to prove what they have learned, both during and immediately after receiving training. Specifically, the program is designed with existing school leaders and their problems are central to the curriculum. As illustrated in Table 2, the curriculum structure comprises three main parts: (1) a professional development workshop series; (2) practice-based courses, and (3) the development of a school improvement project based on prerequisite requirements for the LUP.

Table 2. LUP curriculum structure

No.	Curriculum structure	Number of credits	Term
1	Existing qualifications and work experiences	60	Prerequisite
2	Professional Workshop and Seminar Series	04	1, 2
3	Coursework and Practices	50	1, 2, 3, 4
4	School Improvement Project Report	06	4, 5
Total credits		120	

Source: RUPP, 2019

The primary purpose of conducting the LUP professional development workshop series is to exercise positive thinking towards what a better education practices should be in the present amongst trainees. This type of thinking was connected to coursework. It combined theories and practices used at schools to create a unique learner pathway to addressing school

performance issues. These experiences were used for forming new knowledge about practice improvements, which were compiled as part of the development of school improvement projects.

These 50-credit point courses were designed using six thematic areas including (1) school planning, management, and evaluation; (2) curriculum, assessment, learning and teaching, as well as coaching and mentoring; (3) community engagement and student participation; (4) school internal and external supervision; (5) school administration, environment, finance, and human resources; and, (6) ICT in educational management, learning and teaching, and research. To realize the achievement of the curriculum and to ensure that its upgrade is adaptive, the processes illustrated in Figure 2 was integrated into the blueprint of the training. As can be seen, each course is 45 hours long. However, intensive face-to-face meetings are conducted for 15 hours at the beginning of each course. During this period, theories and concepts for each subject are provided to learners. Each lecturer is an expert working in the field, aligned with the subject.

Figure 2. Training Process in Coursework



Source: RUPP, 2019

The school improvement project report is part of the requirements for the principal trainees graduating from the program. The school improvement project is linked to the coursework in the program and is used to reflect upon how they had learned to successively solve school problems. The LUP uses the

Analysis, Design, Development, Implementation, and Evaluation (ADDIE model) of the school improvement (RUPP, 2019). Trainees started with a specific problem at their school and propose actions to be implemented with relevant stakeholders. After the implementation of the project, they examine how worked and what may be required in terms of further action. The trainees then produce a school case study as part of their school improvement report. The design of the LUP curriculum is based on a residency model. The trainees go through a number of stages: (1) working at a school, (2) being interested to learn new knowledge to improve their work, (3) applying new knowledge at the school, (4) re-learning new knowledge through contextualized practice, and (5) improving their school to meet all nine standards.

These processes happen in a cycle across the course work and practice component. Learners need to develop a personalized school improvement plan based on a variety of influencing factors and conditions. The LUP curriculum is based on the real needs of students, teachers, principals, the MoEYS, and the Royal Government of Cambodia. It is part of an intention to reform practices towards harmonization and sustainable development. Similar to professional business concepts, RUPP as an education service provider prioritizes the learners needs to produce better learning outcomes. After, the LUP curriculum had been developed, the LUP Curriculum Committee allowed some room for adapting the curriculum, as a living document as the training progressed.

Implementing the LUP curriculum with flexibility

The RUPP Faculty of Education is authorized to lead and manage the LUP independently, under the immediate supervision of RUPP management and

representatives of the MoEYS. It is geared towards outcomes-based adaptive learning. The curriculum is flexible in terms of the operation of the school-based management training. Beyond the management and coordination team at RUPP, resource people supported the LUP in different roles across three parts of the curriculum (see Figure 3).

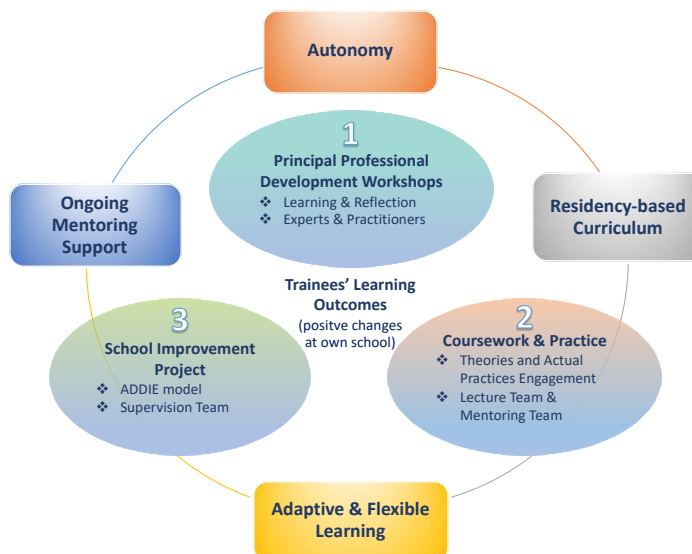
First, LUP professional development workshops were conducted on various topics such as global trends in education, Cambodian education programs in the Rectangular Strategy IV, education sector reforms, school-based management concepts and practices, school leadership in the 21st century, and community school autonomy and accountability. The guest lecturers for this workshop series included the Minister of the MoEYS, Secretary of State, Deputy Director General of Directorate General of Policy and Planning, Director of the General Education Department, the Rector of RUPP, and the World Bank senior education specialist and Principals, who had demonstrated innovation and creativity in their educational leadership. After the lectures, a self-reflection process linking the practice of plan development was carried out to answer the questions *“Where our schools were?”*; *“Where our schools are?”*; *“Where we want our school to be”*; and *“How to get there”*.

By this approach, the program could be viewed as authentic school-based management. The teaching and learning is highly adaptive with respect to each school. These weekend sessions were led and facilitated by a practitioner of school-based management and the LUP team, under the supervision of the Dean of the Faculty of Education at RUPP.

Second, the coursework was delivered using a blended or hybrid learning approach that combined theories, concepts and practices together.

In each course, the initial 15 hours comprised lectures about theories, concepts, and cases led by lecturer team. This team included experts from the SEIP and the relevant departments of MoEYS such as the General Education Department, Quality Assurance Department, Teacher Training Department, and Finance Department. It also included lecturers with direct experiences working in education from RUPP. A mentoring team continuously supported learning tasks for a further 30 hours. They were drawn from experienced educational practitioners from the MoEYS, SEIP, RUPP, civil society, and the private sector. As mentors, they worked in a team to assist trainees at schools in each province, using distance learning through a telegram group. Their main role was to ensure mentees had identified a specific school problem and attempted the implementation of a solution that solved the problem. In this sense, trainees could learn to use practically apply theory.

Figure 3. Alignment between the LUP curriculum, implementation and learning outcomes



The LUP allowed room for both mentors and trainees to communicate their completed learning tasks within the timeframe set. The course delivery in the LUP is flexible based on the current needs of the trainees. Adaptive learning, or simply put, *'teach at the learner's pace'* was also used as a strategy to promote practice-based self-learning using the available resources at each school. Trainees from different schools could work on different issues set within the criteria. Trainees were asked to work on problems they had encountered. The program linked a broad content framework with problem-based content. The school improvement project report was expected to be completed by October 2020. The trainees worked with their supervisors in a provincial grouping by distance learning through telephone calls, telegram messages, as well as face-to-face sessions at RUPP. In practice, supervisors and mentors were the same people. The trainees worked in teams, but separately supported the school for a particular province. That was different from how the program was planned. We learned that as mentors worked on school-based management practices with the trainees, they learned a lot about the school of each trainee and became competent enough to support the school improvement project. For next LUP cohort, this may be re-considered to ensure the supervision of each school improvement project is more adaptive, responsive, and practice-based, resulting from lessons learned from this cohort.

All in all, RUPP as the LUP training service provider played a crucial role in building the capacity of LUP trainees to prove their learning achievements, through work completed at each school. The training program did not end with training activities; but revealed an intention and commitment to reach

another level at the outset. It identified the intended impact of the training program as results. As long as autonomous spaces for implementing the program were provided; adaptive and flexible learning was maintained. The school-based management training enabled trainees to learn more from both the program model and training content.

Conclusion and Policy Implications

It is worth noting that only having a well-designed curriculum does not guarantee the success of a training program. Both curriculum design and implementation must be aligned flexibly towards learning outcomes. The paper provides two key findings. First, the curriculum design emphasized key concepts, content, and a delivery approach, in line with school principal standards; Cambodian school standards; and practical cases of school leadership. Existing competencies and the current needs of trainees were included in the curriculum design. Second, the residency-based curriculum that promotes adaptive and flexible learning in the training program, led to trainees being more motivated to learn. Plenty of room for learner autonomy was allowed, and opportunities for trial and error were provided by the governing body. This is important if innovative practices are to be identified and excel.

A robust training program should occur as a result of these factors. This type of program should possess the following characteristics. First, the program should start with learners in mind. Whatever they know and whatever their challenges are, should be central to driving the structure of the content. This data, sourced from all concerned stakeholders, should continue

to be collected as the program evolves. This approach is called a *progressive data-driven curriculum* or a *living training program*. Second, the means for connecting the existing state to desired learning outcomes must be established. To achieve this, a transparent effort to collaborate with all concerned parties must be established. With knowledge of the characteristics and existing situation of learners, learning to change attitudes should come first. All relevant parties need to work in a team to help learners think positively, feel hopeful, and be open-minded.

Acknowledgement

The Faculty of Education of the Royal University of Phnom Penh is the proud implementer of the SEIP initiated by the MoEYS and the World Bank. The project has been possible as a result of the hard work and efforts of many people. We owe our gratitude to the Minister of the MoEYS, as the Project Director General; Secretary of State as the Project Director, the Rector of RUPP, and the Management Team. We would like to deeply thank the MoEYS SEIP team, who generously provide us with access to relevant documents used to write this paper. We also appreciate the comments and suggestions from the CJBAR editors and reviewers.

Brief Biography

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Urban development in the margins of a world heritage site: In the shadows of Angkor. By Adèle Esposito. Amsterdam: Amsterdam University Press, 2018. 337 pp. Price: €105 (Hardcover) and €104.99 (eBook PDF).

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In this monograph review, I examine how Esposito contextualizes, conceptualizes, problematizes, and operationalizes her work and present her key arguments, as well as my reflections. This book walks us through the emergence of the ‘heritage and non-heritage space’ concepts that have been promoted in many cities in Southeast Asia and internationally. The dominant trend in Cambodia is for urban studies scholarship to focus on the capital city of Phnom Penh; including key issues such as land conflicts (Springer, 2015), real estate development (Fauveaud, 2014), and the eviction of the urban poor (McGinn, 2013) to make way for the development of modern high-rise buildings and satellite cities (Tom, 2016; Nam, 2017; and Yamada, 2018). However, in this book the author problematizes rapid urban transformation in Siem Reap. She shifts our attention towards the second largest city in Cambodia, which attracts more than two million foreign tourists each year (Esposito 2018:48).

Other scholars have tended to focus on macro level issues and the economics of tourism nationally. For instance, Chheang (2008) outlines how the economic value of tourism in Cambodia almost doubled from 823 to 1594 million USD between 2005 and 2006; and Liu et al. (2019) describe how the numbers of tourists arriving at Cambodia's Angkor heritage site increased by around 400% between 2004 and 2017. Meanwhile, Chen, Leask, & Phou (2016) examine symbolic and functional consumption, as well as destination attachment related to cultural heritage. These studies are representative of many more that are framed heavily from a positivist perspective. In contrast, Esposito moves deeper into the human aspects of tourism spaces and tourist practices, in line with her background as an architect and urban planner.

The book is divided into five sections. In the introduction, Esposito contextualizes the concept of tourism spaces and their problematization from the perspective of the urban margins. She also describes her research design and provides an overview of the book. Chapter 1 examines the institutional practices of heritage management from an architectural point of view. Esposito focuses on a triad of concepts: including the foundations of the monuments, their boundaries, and the parks which have formed as part of the colonial and post-colonial legacy of heritage preservation and development in Siem Reap.

Drawing from an alternative lens of anthropology and development practice, Chapter 2 examines the interplay of key actors, including international donors, consulting firms, and the national institutions that have been established since the early 1990s; as well as how they have used their knowledge, skills, and ideas to shape the development of the city. The author

illustrates how two former enemies of the country during World War II, the French and Japanese, have been highly influential in planning the spatial layout of the city; through development models known as the vegetal city and compact city, respectively.

Chapter 3 positions the city as a playground, laboratory, or urban development experiment. Using the same worldview that frames Chapter 2, Esposito builds on the work of de Certeau (1984) regarding the tactics and strategies employed by donors, development agencies, business tycoons and groups of consultants to conceal information about capital investment and gain access to land resources. Details about the development practices observed in the Wat Bo and Taphul areas, two urban cores along the eastern and western side of National Road No. 6, respectfully, are outlined.

Chapter 4 shifts back to an architectural perspective, examining role of architectural spaces in developing a modern city and a series of replica that represent and reconstruct local realities. This includes the reconstruction of monuments, traditional Khmer wooden houses, restaurants, and cafés to create a realistic local culture with emotional authenticity. This is used to attract foreign visitors and an emerging Khmer middle class for tourism purposes. The book demonstrates how Cambodia has used the concept of urban heritage and tourist spaces to promote urban development through the preservation and restoration of a designated UNESCO World Heritage site. Further, it describes how this has been used to revitalize the economy Siem Reap, as a tourist destination by co-operating with regional and international networks.

Alongside this transition, the author describes two models of urban governance that have emerged. First, the Angkor site, which received international recognition and UNESCO World Heritage status in 1992 and has attracted an influx of investment and development aid from donors, international development agencies, consulting firms and other professionals through the imposition of neoliberal development practices is analyzed. Then, the nature of existing cultural practices embedded within social structures and how they have evoked the adoption of neo-patrimonialism is addressed. It is shown how this has blended modern bureaucracy with personalized patron-client relations, with no delineation between the public and private realm. While this was a feature of European society in the Middle Ages, where power networks of political elites and business tycoons were constructed through family alliances and marriage to gain control over strategic resources; it has not typically been a feature of Cambodian society.

In recent years, these two models have both exerted a strong influence over the power structures and institutions of the country. Emerging actors have emerged to manipulate institutions, rules, and regulations (Esposito 2018:28). While this concept was not fully elaborated on, it may be related to the dominant strategic groups described by Evers and Korff (2000), as influenced by structuration theory (Giddens, 1984). The concept of strategic groups, including both dominant and subordinate groups, remains relevant in the Cambodian context, as it cuts across social classes and structures. This has occurred mostly through emerging migrant groups of business men that have settled in the country over generations.

Drawing from her early work between 2005 and 2006, a one year period where she resided in Siem Reap in 2007, as well as follow up visits in 2015; Esposito uses three major approaches to understand the urban transition of Siem Reap. Firstly, as an architect, she observes, describes, and diagnoses the malfunction of built forms within urban spaces, using design tools to create solutions dictated by strict, normative guidelines. Secondly, she uses the historical tools of urban planning to describe the concepts of zoning and inventory, introduced by colonial governments, but later standardized among contemporary urban planners. Yet, this did not enable her to development knowledge about how different groups and actors perceive and contest non-heritage spaces. Her third approach using political anthropology and development theories did. In it, she focuses on rules and regulations and the collective tactics of strategic groups of concealing, evading, and manipulating access to non-heritage spaces. Using this perspective, her study shows that tourism promotion in Siem Reap has taken place largely after the colonial regime.

The production of tourism service industries and non-tourist spaces has been influenced by both professional and international development agencies, known as cultural brokers. Esposito examines how spaces have been created through land-use zoning and inventory. She articulates how two urban planning models led by international donors have been used to contest urban space in Siem Reap. The first, introduced by the French Development Agency (AFD) prioritized vegetation and water as major focal points for urban planning. The design of roads, canals and artificial lakes are often associated with this model, which is very much in line with the Khmer cosmology of urban

spatial arrangement. The second, known as the compact city model was introduced by the Japan International Cooperation Agency (JICA). It emphasizes land-use efficiency as part of the development of urban spaces to prevent urban sprawl and the overexploitation of resources. However, this model has only been shown to have potential if the required skills, attitudes, and technologies are in place.

The planning tools of land-use zoning and inventory have played a critical role in expanding development to non-heritage spaces such as tourist enclaves, the port at the Tonle Sap, and potential exclusion zones that impact local residents; especially the urban poor. With this knowledge, Esposito shifts her analysis from the structure-oriented approach that uses normative standardized, urban planning concepts and architectural models towards an analysis of tactics and strategies adopted by various strategic groups. Esposito examines how these groups, including architects and real estate developers, have acquired power that enables them to extend their influence over urban spaces designated for development. She describes how tactics, such as the diversion of land laws, concealing information about the origins of investment capital, and negotiating the ongoing diluting of urban regulations have been used to better serve their interests.

The production of cultural and heritage tourism spaces has also been influenced by local architectural design. However, modern tourist spaces have been constructed with an emotional authenticity that blends both traditional Khmer and modern architecture. White, European worldviews that have valued the preservation of colonial buildings and traditional wooden houses may be compared with modern infrastructure in this way. Traditional, wooden

Khmer housing has been restored and promoted to attract foreign visitors to give them an opportunity to experience authentic, local culture. Esposito applies an anthropological lens to tourism using this knowledge to accurately demonstrate how authenticity, tradition, and identity have been reconstructed to create a unique culture where traditional Khmer wooden houses, restaurants and hotels are designed to represent specific meanings, and an image of the city. She identifies how the consequences of the restrictions, regulations and zoning rules of urban heritage conservation, manifested through the '*APSARA conservation zone*' interplay with the local agency of residents when they contest the economic benefits of tourism spaces and their exclusionary practices.

Esposito clearly demonstrates how tourism and heritage programs have been a major factor in influencing urban revitalization, reflected not only in the case of Siem Reap, but also in other Southeast Asian cities include Battambang, in the neighboring province of the same name. This argument entails the co-existence of local and colonial buildings, as well as post-colonial architecture in places where urban development and cultural identity have been framed as a legacy of economic development and the restoration of a national identity. She suggests that the colonial regime has left significant resources to build and create stories that promote attractive tourism sites.

Esposito concludes that the conceptual models of both heritage and non-heritage spaces have been key to understanding the relationship between recognition of the Siem Reap-Angkor archeological park with UNESCO World Heritage status; and the influence of key actors over these designated spaces. To achieve this, she draws from the work of Sack on human

territoriality (Sack, 1986). This may be defined as the ability to exert control over objects, people, and their relationships within bounded territories. This concept has led to the formation of a national authority, APSARA, but questions remain about how this system of control over heritage spaces may continue to be enforced.

With this in mind, Esposito invites us to appreciate the Khmer cosmology of the city, elaborating on the concept of *Tuek* (water) and *Dei* (land), being combined into a territory as *Tuekdei* (space). Her approach has predominantly drawn from architectural, urban planning and anthropological perspectives and as such, she tends to focus more on dominant strategic groups. However, the role of subordinate groups, who may be drawn from local residents affected by heritage restrictions; and other actors, including those residing in informal settlements must also be considered. These groups are also involved in developing networks with civil society, the media and local politicians to contest the allocation of local resources and development spaces in the city.

Esposito's book may be read alongside other classical books written by McGee (1957), who first examined the role and function of Southeast Asian cities between precolonial and postcolonial times; as well as Evers & Korff (2000) who examines urbanism in southeast Asia. The latter examines the city through the concept of emerging strategic groups, or migrant businessmen who exert influence over the politics and economics urban spaces via the strategic resource allocation that occurs as part of an urban transition. The concept of a tourism gaze (Urry and Larsen, 2011) may also provide a background understanding of how tourists come to appreciate places and buildings framed as local traditional architecture, culture and experiences. The

original ideas Esposito presents about 'the function of zoning, inventory, and classification' that have been adopted by urban planning since colonial times, when regulations, laws and institutions were imposed may be enhanced by these complimentary resources.

Many urban development interventions aimed at improve human conditions have often failed to meet their intended outcomes. Yet, this book tells us more about heritage and non-heritage spaces being imposed by dominant groups, rather than how residents and subordinate groups resist in a struggle to gain access to these spaces. This leads to the idea that if urban planning is the better improve human conditions, there is a need for: autonomous state institutions that are less influenced by neo-patrimonialism and neoliberalism; greater trust in civil society; and greater use of local knowledge and participation in a shared urban development agenda. Esposito's book confirms that while the Angkor cultural and heritage tourism sites have become key resources for the reconstruction of a national identity, cultural consumption, and economic growth; there is a still need to rethink the consequences of uneven development as a result of tourism.

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Brief Biography

Try Thuon recently graduate from a PhD in Social Science from Chiang Mai University focused on the politics of urban space making in Cambodian

secondary towns. He is a professional researcher, with over a decade of experience with interests in resource politics, livelihood systems, urban climate resilience, an urban transformation and conflict. He is an adjunct researcher and lecturer with the Faculty of Development Studies (FDS) at the Royal University of Phnom Penh. He is currently engaged with research on gender, ethnic relations and water security in the context of the wetlands along Cambodia-Vietnam border, funded by the Stockholm Environmental Institute (SEI); as well as research on water vulnerability within fragile socio-ecological systems, funded by the Academy of Finland (grant number: 1317319) through the University of Helsinki.

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Instructions for Authors

About the Journal

Insight: Cambodia Journal of Basic and Applied Research was established in 2018 by the Royal University of Phnom Penh (RUPP). It is an academic, policy and practice-oriented journal, which covers all aspects of science and engineering, the social sciences and humanities, education, development studies, and languages. The publisher, RUPP, was founded in 1960 and is the oldest and one of the largest public universities in Cambodia. It has a full membership of the ASEAN University Network (AUN) and is considered to be Cambodia's flagship university in teaching, research, and community service. Academic or applied research manuscripts from within Cambodia; or from outside Cambodia but contributing to the social, economic, or environmental development of Cambodia, ASEAN, or the Greater Mekong Subregion may be submitted to the journal. The journal welcomes manuscripts from any discipline, where theories, concepts, innovations, new technologies, or best practices are introduced. However, the journal reserves the right to prioritize research focused on topics aligned with the courses offered at RUPP.

Frequency of Issue

Insight: Cambodia Journal of Basic and Applied Research is a bilingual journal, where manuscripts may be published in either English or Khmer. However, all manuscripts must have abstracts in both English and Khmer. Two issues of the journal are published each year:

- Issue 1: January-June

- Issue 2: July- December

Each volume will comprise one editorial, five research papers, one policy paper, and a book review.

Manuscripts Accepted

Natural Science, Science, and Engineering

- Original research paper (3,000 – 5,000 words, including references)
- Short policy paper (1,000–2,000 words, including references), and
- News (< 500 words)

Arts, Linguistic, Humanities, Social Science, Development Studies and Environment

- Original research paper (6,000 – 8,000 words, including references),
- Short policy paper (1,000 – 4,000 words, including references), and
- News (< 500 words).

Manuscript Submission and Evaluation

The journal editors warmly welcome your submissions. Papers sent for consideration should be submitted electronically in Word format to Dr Serey Sok at the Research Office of the Royal University of Phnom Penh (cjbar@rupp.edu.kh). Submissions should include: (1) a full paper, (2) a cover page, and (3) supplementary data (if required).

Peer Review Integrity

All manuscripts considered for publication will undergo a process of double-blind peer review by independent expert referees. An internal evaluation will occur before the peer review process. The editor will inform the author whether the manuscript has been accepted or rejected within one month of

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- **Accepted without changes.** If a manuscript is evaluated as “*Accepted without change*”, it is published in its original form.
- **Accepted with minor changes.** If a manuscript is evaluated as “*Accepted with minor changes*”, the editor will accept the submission on revision of some minor aspects of the paper.
- **Accepted with major changes.** If a manuscript is evaluated as “*Accepted with major changes*”, it will require an additional external evaluation by the peer review team.
- **Rejected.** If a manuscript is evaluated as “*Rejected*”, it will not be accepted for re-submission, regardless of how it is later revised.

When the author is notified of acceptance to the journal, the editor will forward comments from the two peer-reviewers for consideration. Where a manuscript requires changes, the author will be given 30 days to review the manuscript. The author may be offered one or more rounds of review to change the manuscript meet the minimum standards required for publication in the journal.

An original research paper may vary in structure based on specific requirements of the topic, or the disciplinary background of the author(s), in terms of experiments, surveys, case studies, and so on. However, authors will need to collect and analyze new data and conduct an original study. The paper should be based on analysis and interpretation of this data. The suggested structure for a paper in this category is as follows:

- Introduction,
- Conceptual framework/literature review,
- Methodology,
- Findings and Results,
- Discussion,
- Conclusion,
- References, and
- Supplementary Data (if required).

A book review is an analysis of a book, including its contents, style, and merit.

A book review may be written as an opinion piece, summary, or scholarly review. The suggested structure for a book review is as follows:

- Introduction,
- Body (a review of the contents of the book),
- Analysis and evaluation,
- Conclusion, and
- References.

A short policy paper is a communication piece focusing on a specific policy issue, which provides clear recommendations for policymakers. It is generally a preliminary study, which is a precursor to an original research paper. A manuscript for a short policy paper should use the following structure:

- Abstract,
- Introduction,
- Research methodology,
- Results,

- Discussion,
- References, and
- Supplementary Data (if required).

A news item is a brief description of a research project and an outline of some preliminary results. This provides an opportunity for authors to disseminate important results quickly. A news item should adhere to the following structure:

- Introduction,
- Aims and objectives,
- Research methodology,
- Preliminary results (if relevant),
- Discussion, and
- References.

Referencing Style

Insight: Cambodia Journal of Basic and Applied Research (CJBAR) has adopted the American Psychological Association (APA) style as referencing style.

How to cite a book in APA style

Citing a book in print

APA format structure:

Author, A. (Year of Publication). *Title of work*. Publisher City, State: Publisher.

For example:

Finney, J. (1970). *Time and again*. New York, NY: Simon and Schuster.

Notes: When citing a book in APA, keep in mind:

- Capitalize the first letter of the first word of the title and any subtitles, as well as the first letter of any proper nouns.
- The full title of the book, including any subtitles, should be stated and *italicized*.

Citing an e-book from an e-reader

E-book is short for “electronic book.” It is a digital version of a book that can be read on a computer, e-reader (Kindle, Nook, etc.), or other electronic device.

APA format structure:

Author, A. (Year of Publication). *Title of work* [E-Reader Version]. Retrieved from <http://xxxx> or DOI:xxxx

For example:

Eggers, D. (2008). *The circle* [Kindle Version], Retrieved from <http://www.amazon.com/>

Citing a book found in a database

APA format structure:

Author, A. (Year of Publication). *Title of work*. Retrieved from <http://xxxx> or DOI:xxxx

For example:

Sayre, Rebecca K., Devercelli, A.E., Neuman, M.J., & Wodon, Q. (2015). *Investment in early childhood development: Review of the World Bank’s recent experience*. DOI: 10.1596/978-1-4648-0403-8

Note: When citing an online book or e-book in APA, keep in mind:

- A **DOI** (digital object identifier) is an assigned number that helps link content to its location on the Internet. It is therefore important, if one

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How to reference a magazine in APA style

Citing a magazine article in print

APA format structure:

Author, A. (Year, month of Publication). Article title. *Magazine Title*, Volume(Issue), pp.-pp.

For example:

Tumulty, K. (2006, April). Should they stay or should they go? *Time*, 167(15), 3-40.

Notes: When citing a magazine in APA, keep in mind:

- You can usually find the volume number with other publication information in the magazine;
- You can usually find page numbers in the bottom corner of a magazine article; and
- If you cannot locate an issue number, simply exclude it from the citation.

Citing a magazine article found online

APA format structure:

Author, A.A.. (Year, Month of Publication). Article title. *Magazine Title*, Volume (Issue), Retrieved from <http://xxxx>

For example:

Tumulty, K. (2006, April). Should they stay or should they go? *Time*, 167(15)

Retrieved _____ from

<http://content.time.com/time/magazine/article/0,9171,1179361,00.html>

Notes: When creating an online magazine citation, keep in mind:

- The volume and issue number aren't always on the same page as the article. Check other sections of the website before excluding these details from the citation.

How to reference a journal article in APA style

Citing a journal article in print

APA format structure:

Author, A. (Publication Year). Article title. *Periodical Title*, Volume (Issue), pp.-pp.

For example:

Nevin, A. (1990). The changing of teacher education special education. *Teacher education and special education: The Journal of the Teacher Education Division of the Council for Exceptional Children*, 13 (3-4), 147-148.

Citing a journal article found online

APA format structure:

Author, A. (Publication Year). Article title. *Periodical Title*, Volume (Issue), pp.-pp. DOI:XX.XXXXX or Retrieved from journal URL

For example:

Jameson, J. (2013). E-Leadership in higher education: The fifth "age" of educational technology research. *British Journal of Educational Technology*, 44 (6), 889-915. DOI: 10.1111/bjet.12103

Notes: When creating an online journal article citation, keep in mind:

- APA does NOT require you to include the date of access/retrieval date or database information for electronic sources.

- You can use the URL of the journal homepage if the reference was retrieved online and there is no DOI assigned.

For example: Retrieved from [http://onlinelibrary.wiley.com/journal/10.1111/\(ISSN\)14678535;jsessionid=956132F3DE76EEB120577E99EE74CE9C.f04t01](http://onlinelibrary.wiley.com/journal/10.1111/(ISSN)14678535;jsessionid=956132F3DE76EEB120577E99EE74CE9C.f04t01).

- A **DOI** (digital object identifier) is an assigned number that helps link the content to its location on the Internet. It is important to use it on a citation if one is provided. All DOI numbers begin with a 10 and are separated by a slash.

How to reference a newspaper in APA style

Citing a newspaper article in print

APA format structure:

Author, A. (Year, Month Date of Publication). Article title. *Newspaper Title*, pp. xx-xx.

For example:

Rosenberg, G. (1997, March 31). Electronic discovery proves an effective legal weapon. *The New York Times*, p. D5.

Notes: When creating newspaper citation, keep in mind:

- Precede page numbers for newspaper articles with p. (for a single page) or pp. (for multiple pages).
- If an article appears on discontinuous pages, give all page numbers, and separate the numbers with a comma (e.g., pp. B1, B3, B5-B7).

How to cite a website in APA style

Citing a general website article with an author

APA format structure:

Author, A. (Year, Month Date of Publication). Article title. Retrieved from URL

For example:

Simmons, B. (2015, January 9). The tale of two Flaccos. Retrieved from <http://grantland.com/the-triangle/the-tale-of-two-flaccos/>

Citing a general website article without an author

APA format structure:

Article title. (Year, Month, Date of Publication). Retrieved from URL

For example:

Teen posed as doctor at West Palm Beach hospital: police. (2015, January 16). Retrieved from <http://www.nbcmiami.com/news/local/Teen-Posed-as-Doctor-at-West-Palm-Beach-Hospital-Police-288810831.html>

See details: <http://www.bibme.org/citation-guide/apa/>

Insight

Cambodia Journal of Basic and Applied Research (CJBAR)



This journal has been approved by the Ministry of Information upon RUPP's request, No. 770/2018 RUPP, dated on 16 August 2018. The preparation and printing of this volume was generously supported by the Research Office of the Royal University of Phnom Penh, who also provided technical support in hosting, editing, and publishing the Cambodia Journal of Basic and Applied Research (CJBAR).

The Royal University of Phnom Penh (RUPP) is the oldest and the largest public university in Cambodia. It has contributed significantly to development of human resources for many sectors, especially to the training of teachers in high schools and other public servants. With respect to Cambodia's integration into the ASEAN Economic Community in 2015, the role of RUPP in furthering the scope of these achievements will need to be improved and strengthened accordingly. A situation analysis has shown that RUPP faces with considerable challenges in the further development of capacity in Cambodia, requiring comprehensive reform in terms of leadership and management, administration, and financing of the university. Our goal is to position the right people in the right place, improving teaching and learning methods, enhancing institutional capacity for research and development, and developing infrastructure and campus services. We believe this is essential for transforming RUPP into the flagship public university in Cambodia. Currently, 6% of our full-time staff hold doctoral degrees, 64% have master's degrees and 93% of our administration and finance staff are qualified to at least a bachelor degree level. We have almost 20,000 students and have more students receiving support from scholarships and fee waivers than any other large publicly funded university in Cambodia.

News

Higher Education Improvement Project (HEIP) activities

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Higher education in Cambodia: Engendered, postcolonial Western influences and Asian values

Policy Paper

Capacity building of secondary school principals: A case study of the School Leadership Upgrading Program (2019-2020) at the Royal University of Phnom Penh (RUPP)

Book Review

Urban development in the margins of a world heritage site; In the shadows of Angkor. By Adèle E spósito. Amsterdam: Amsterdam University Press, 2018 . 337 pp. Price : €105 (Hardcover) and €104.99 (eBook PDF).

