Socio-Economic Impact Assessment & Framework:

NET PRACHARAT

August 2022

Dr. Yong Yoon

DISCLAIMER

The designations employed and the presentation of the material in this publication do not imply the expression of any opinion whatsoever on the part of ITU concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

The mention of specific companies or of certain manufacturers' products does not imply that they are endorsed or recommended by ITU in preference to others of a similar nature that are not mentioned. Errors and omissions excepted, the names of proprietary products are distinguished by initial capital letters.

All reasonable precautions have been taken by ITU to verify the information contained in this publication. However, the published material is being distributed without warranty of any kind, either expressed or implied. The responsibility for the interpretation and use of the material lies with the reader.

The opinions, findings and conclusions expressed in this publication do not necessarily reflect the views of ITU or its membership.

Acknowledgements

The Socio-Economic Impact Assessment and Framework: Net Pracharat was prepared by Dr. Yong Yoon from the Chulalongkorn University and the ITU Regional Office for the Asia-Pacific. The ITU appreciates the cooperation of the government agencies and institutions, partners, and organizations that provided information on the Net Pracharat project incorporated into this report.

Further, the ITU acknowledges and appreciates all stakeholders and representatives from the National Broadcasting and Telecommunication Commission (NBTC), the Ministry of Digital Economy and Society (MDES) and its Foreign Relations Department, the National Statistical Office (NSO), and the Telephone of Thailand Public Company Limited (TOT) for sharing critical information and materials on Net Pracharat, which has further substantiated the findings and recommendations of this report.

Table of Contents

I. Introduction

The Village Broadband Internet Project or Net Pracharat is a flagship national digital infrastructure development project of the Ministry of Digital Economy and Society (MDES), the Telephone of Thailand Public Company Limited (TOT), and the National Broadcasting and Telecommunication (NBTC) that aims to strengthen broadband network across the country by establishing high-speed Internet access in every village.

The Net Pracharat project aims to reduce inequality by providing communities with equal access to government services, especially during the pandemics, as well as increase the economic and social potential of target villages by advancing the Thai people's career, income, education, public health, agriculture and online trading, among others as a step towards the national vision of "Thailand 4.0."

This report serves as a desk review and analysis of a handful of studies that describe and examine the impact of Net Pracharat over the past few years since its inception in 2016. This report is based on four primary studies/sources:

(1) the National Statistics Office (NSO) survey of people's opinions towards the Net Pracharat Internet Project (2018) jointly undertaken with MDES, (2) the APT Report on Best Practice of Connectivity (2019), (3) Chiang Mai University (CMU) Inception Report (2021), and (4) The Internet Use of Net Pracharat Villages Report - January to June 2020, from the Digital Economy and Society Development Driven Center, Office of the Permanent Secretary.

In order to further improve the MDES Net Pracharat project, this report serves as an initial assessment to help identify approaches for a comprehensive assessment of the Socio-economic impact of the Net Pracharat project. The report is for key stakeholders especially MDES and NBTC as they continue to consider improving Net Pracharat services.

In sum, even with the many potential benefits to the Thai citizenry, especially in remote and rural areas, a comprehensive, up-to-date assessment of the socio-economic impact of the Net Pracharat was found to be largely absent. Further quantitative (difference-in-difference method) and qualitative research (questionnaire and interviews) are suggested for a proper scientific assessment of the Net Pracharat to assess its socio-economic benefits and costs better.

II. Net Pracharat

As the Government of Thailand moves towards Thailand 4.0,[1] it has given priority and importance to driving the digital economy forward by incorporating technology to accelerate economic and social development. One of the key driving activities identified by policymakers is to develop the country's basic telecommunications infrastructure, particularly through the National Broadband Network, which aims to make broadband (or high-speed Internet) services available to all Thai citizens across the country.

A. Project Objectives

In line with the Thai government's vision and policies, the Village Broadband Internet (or Net Pracharat) Project was launched to strengthen the country's broadband network by expanding the high-speed Internet network to reach every village in the country, particularly to villages in rural/remote and non-marketable areas that private telecom operators do not service under existing market conditions. The objectives of Net Pracharat include:[2]

1) To enhance telecommunication infrastructure by installing a high-speed Internet network with Fiber-To-The-X (FTTX) technology to targeted villages and support effective network expansion in the future;

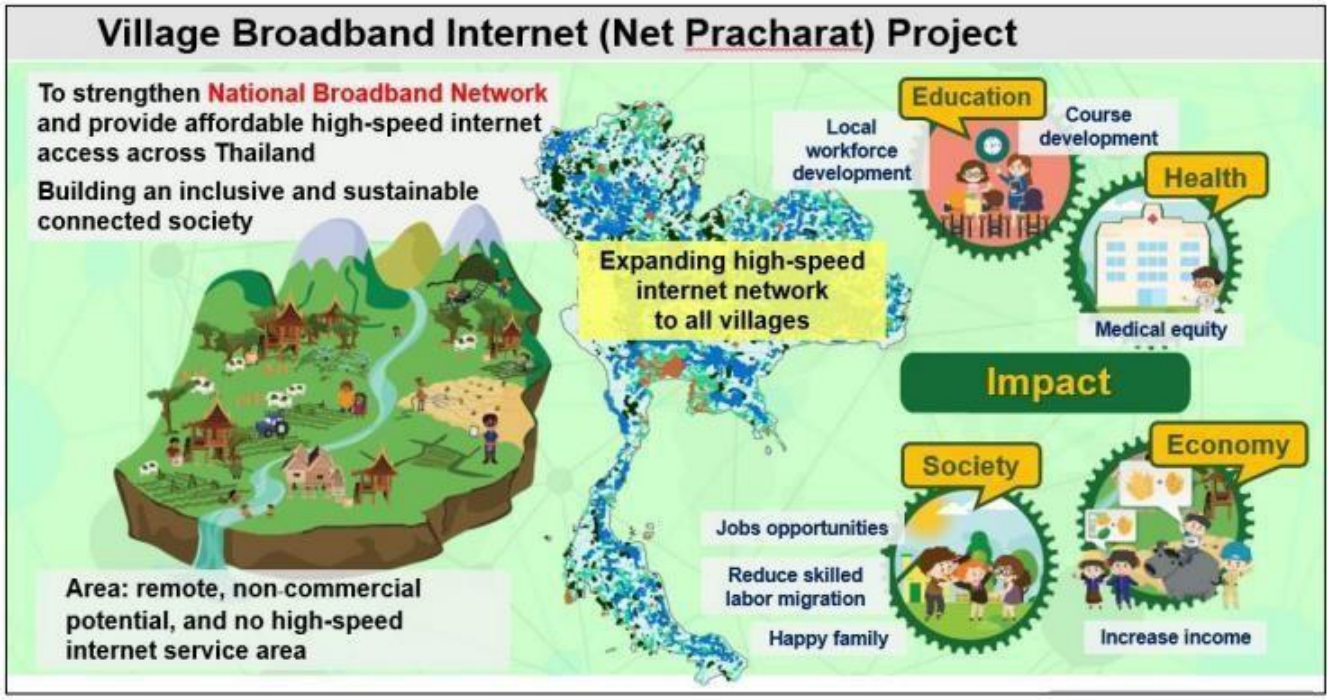
2) To decrease inequality among people in the targeted villages to access high-speed Internet network and provide opportunities to obtain public services equally and thoroughly, leading to better quality of life; and

3) To enhance the economic and social potential of the targeted villages such as career building, income generation, as well as access to education, public health, agriculture, and online trading services. With Net Pracharat, local people are able to access useful online content and services such as e-Commerce, e-Education, and e-Health. This generates beneficial impact on both society and economy (e.g., creating job opportunities, increasing income for local communities, and reducing skilled labour migration).

[1] Thailand 1.0 (agriculture); 2.0 (light industries characterized by low wages); 3.0 (heavy industry and advanced machinery), and Thailand 4.0 (driven by creativity, knowledge, innovation and digital transformation). This digital transformation is based on a digital economy, digital government, digital workforce and digital society.

[2] Office of Permanent Secretary (2020, pp. 15-16) and APT Report (2019, pp. 14-15).

Figure 1: Objectives of Net Pracharat Project



Source: APT Report, 2019, p. 15

B. Project Financing

The initial capital expenditure of USD 318 million for the network deployment and installation of Wi-Fi hotspots was funded through the national budget of the government. More specifically, funds were used to cover the following:

1. **Network and System Installation (2016 - 2017):** construction of fiber optic cable networks and installing public Wi-Fi hotspots at 24,700 target villages (1 hot spot per village).

2. **Network Maintenance and Wi-Fi service (2017-2018):** Provision of network maintenance operations and Wi-Fi services with speeds of up to 30/10 Mbps (download/upload) after the completion of network installations from 2017-2018 (see APT Report, 2019, p. 21).

The operational expenses and maintenance of the Net Pracharat network and Wi-Fi services in villages from 2019-2023 are financed though the Universal Service Obligations (USO). This financing mechanism aims to sustain the project and further expand the broadband Internet market in these areas until they develop into self-sustaining profitability.

III. Net Pracharat Reports and Assessments

A. Asia-Pacific Telecommunity Report (2019)

The APT Report provided a comprehensive background of the Net Pracharat project and its aims to expand Thailand's broadband Internet coverage to connect unconnected villages especially allowing the local Thai people who live in the remote areas to access broadband or high-speed Internet as those who live in the cities, resulting in the bridging of the digital divide and building an inclusive and sustainable connected society.

Village Connectivity

By December 2017, the Ministry of Digital Economy and Society (MDES) and the Telephone of Thailand Public Company Limited (ToT) completed the installation of fibre optic cable networks and connected 24,700 target rural villages. In support of this, the ToT installed 24,700 free public Wi-Fi hotspots (one per village) strategically located in public areas and buildings with speeds of up to 30/10mbps. The newly established infrastructure increased the access of unconnected and under-connected Thai citizens to the Internet and contributed to connecting approximately 6.6 million registered Net Pracharat users by July 2019 (see NSO, 2018; APT, 2019).

Following its extensive network installation, Net Pracharat gained significant ground in expanding its broadband Internet coverage and by June 2020 the project had connected 30,635 villages in urban and suburban areas (commercially viable) and 44,352 villages in rural and border areas (non-commercially viable), thereby connecting a total of 74,987 villages. As seen in the table below, MDES operates 24,700 villages, while NBTC operates 15,732 villages in rural areas. As for Border Area villages, the NBTC, through the Universal Service Obligation (USO), operates 3,920 villages (APT Report, 2019).

Table 1: Net Pracharat Project Target Area

Total 74,987 villages* (100%)			
30,635 villages (41%)		44,352 villages (59%)	
Zone A Urban Area	Zone B Suburban Area	Zone C Rural Area 40,432 villages	Zone C+ Border Area 3,920 villages
Commercial Area		Non-Commercial Area	
Non-Target Area		MDES (24,700) NBTC (15,732)	NBTC (3,920)
		Fiber Optic	Fiber Optic Satellite

Note* Number of total villages referred from NTBC's GIS map (Feb 1st, 2017)

Source: APT Report 2019, p. 20

Awareness Campaigns and Capacity Building

To increase awareness and promote the use of Net Pracharat, MDES conducted workshops that trained over 1,000 officers from the Office of the Non-Formal and Informal Education (NFE), which is under the Ministry of Education (MOE). The workshops set up a leading group of Net Pracharat trainers, who would then train some 100,000 local people in Net Pracharat village areas. By September 2018, in collaboration with the Ministry of Interior (MOI), training reached over 1,000,000 local people equipping them with the necessary knowledge and skills to take advantage of Net Pracharat services.

Additionally, the project recruited volunteers with digital skills from local communities to further facilitate the utilisation of the internet provided through this project (see APT Report, 2019, p. 52).

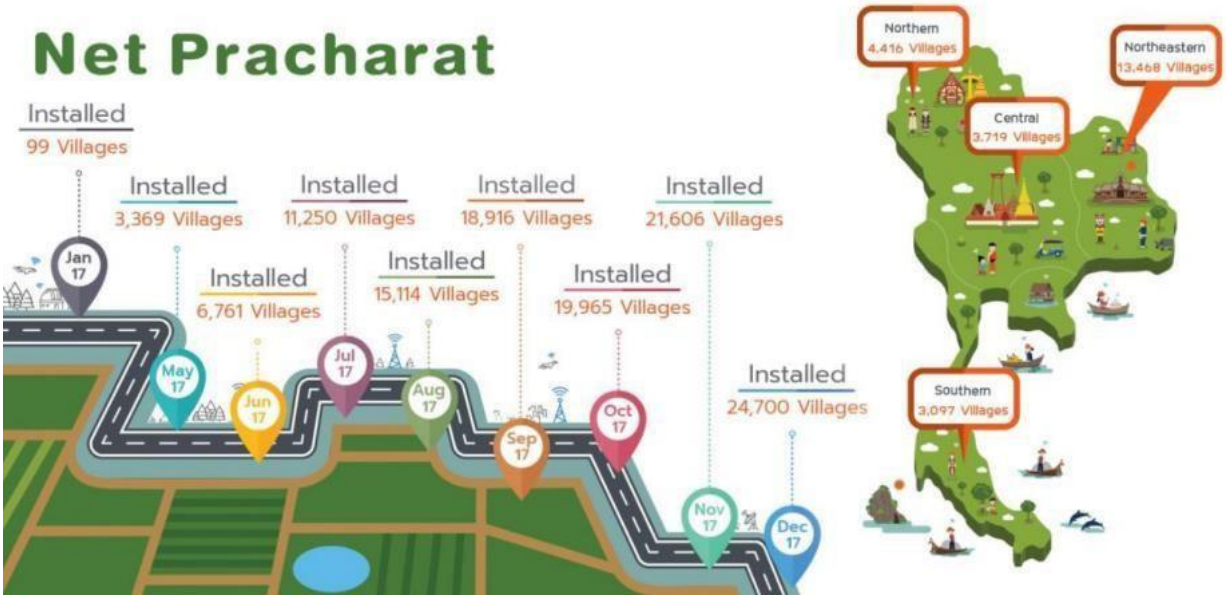
Open Access Network

The Net Pracharat network is envisioned to operate as an open-access network. This would allow any network service provider with a license from the NBTC to connect and use the Net Pracharat network without fees. This would allow them to provide internet services to last-mile customers with fair and affordable prices for Net Pracharat villages. Through this, the rural areas will eventually become commercially viable.

In principle, telecommunication operators with and without their own network can connect to the Net Pracharat network without service charges. This would facilitate the establishment of small telecommunications

operators in the region, which would create a competitive service that will reduce service costs to the public. At present, there are four (4) telecommunication operators that signed a license agreement for the use of the Open Access Network, while seven (7) had submitted their applications.[3]

Figure 2: Net Pracharat Network Installation and Milestone



Source: APT Report, 2019, p. 26

In July to September 2018, the National Statistical Office (NSO) conducted a field survey to collect villagers' opinions and satisfaction toward Net Pracharat. NSO interviewed 2,577,231 local people in the 24,700 Net Pracharat villages (See Section C below for further analysis with survey data). The main findings showed that more than 73% of participants appreciated the benefits of high-speed Internet networks. Local people expressed that Net Pracharat helped enhance quality of life for local villagers, provide opportunities for earning a living, generate income supplement, and facilitate the search for useful information related to health, agriculture, and education. More than 86% however thought that more public Wi-Fi hotspots should be installed throughout their villages.[4] Arguably, the survey in 2018 was too early to capture socio-economic benefits of the project's impacts which would take some time to take effect.

B. Office of Permanent Secretary Report (2020)

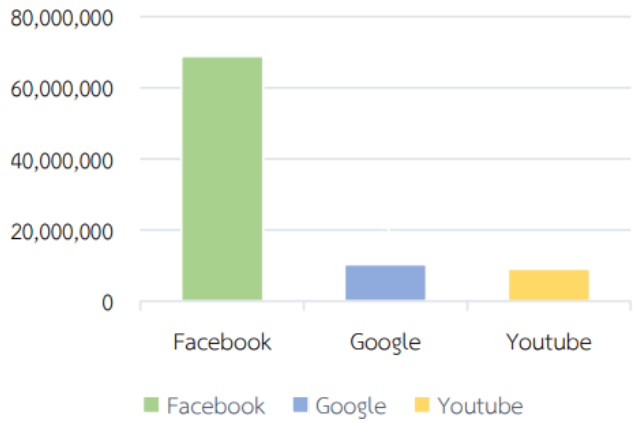
Internet use of Net Pracharat villages in the Office of Permanent Secretary (2020) report covering January to June 2020 is derived from

[3] Office of Permanent Secretary (2020, p. 27)
[4] APT Report (2019, p. 39)

the 2018 survey of Net Pracharat villages by NSO and the monthly internet use of Net Pracharat villages from January to June 2020 by the Network Operation Center (NOC).[5]

Accordingly, data on internet traffic (total of upload and download quantity) from January to June 2020 show that internet traffic averaged between 5,000 to 6,000 GB per month with an estimate of 2-3 million devices connected. Most of the internet traffic were directed to Facebook (68,824,805 views/day) followed by Google and Youtube (10,315,362 views/day and 9,077,420 views/day). In the same report, a breakdown of the amount of internet traffic was also identified by villages across various products, occupational groups, tourist spots or accommodations such as homestays, resorts, unique traditions, local wisdoms and others.

Figure 3: Most Popular Application per Day (Views) Jan-July 2020



Source: Office of Permanent Secretary 2020, p. 16

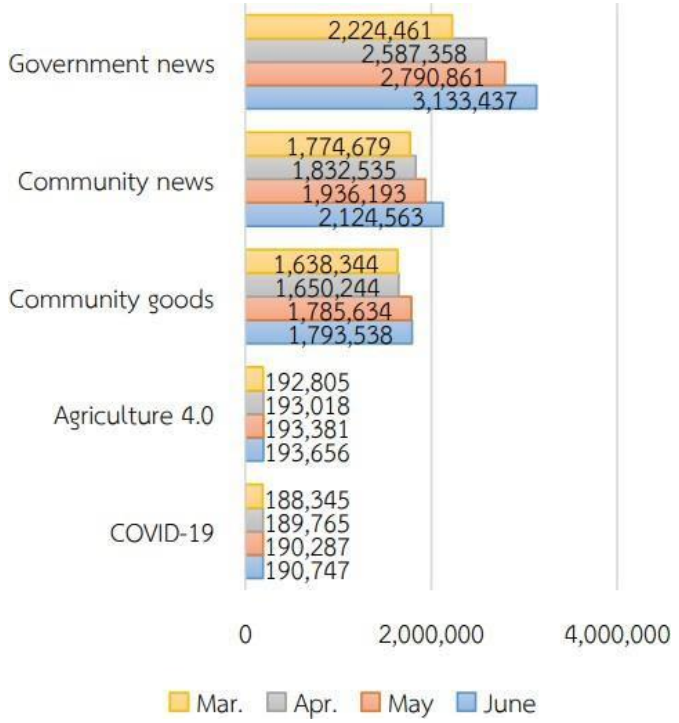
Finally, it is also worth mentioning that MDES has initiated an awareness campaign for the project's stakeholders including over 100,000 community leaders, 30,000 community entrepreneurs, 85,000 Net Pracharat lecturers, and more than 8,500 local government officials (Office of Permanent Secretary, 2020, p. 26).

The campaign, facilitated by a representative from MDES, briefed all participants on the Net Pracharat, particularly on its objectives and services to apply and cascade this knowledge to the communities they live in. They are an important network for communicating, coordinating and providing information through Net Pracharat (NPCR) Volunteer Network

[5] The APT Report (2019) shows that dashboard data from a network monitoring system are available for the Net Pracharat project, which presumably coincide with data collected by the Network Operation Center (NOC) used in the Office of Permanent Secretary Report (2020). Due largely to Covid-19 restrictions, dashboard data was inaccessible and a comprehensive "descriptive, diagnostic, predictive and prescriptive" analysis is not contained in this assessment report.

and its NPCR Volunteer Network digital application,[6] which has become an important source of news and government services among Net Pracharat users especially during the Covid-19 pandemic, and for general information on restaurants, tourist spots and other local services.

Figure 4: Most Views (Times) Jan-July 2020



Source: Office of Permanent Secretary 2020, p. 18

Furthermore, the report on internet usage identified rice farmers as the occupational group with the highest Net Pracharat internet usage in the first half of 2020. This is three to five times more than other occupational groups (crop farmers, rubber planters, orchardist and general contract workers).[7] Internet traffic also differed among occupational groups depending on region. For example, while rice farmers in the North and Northeast regions had the highest internet traffic, South rubber planters showed the highest internet traffic.

[6] The cumulative application downloads steadily increased every month in early part of 2020 during the outbreak of the Covid-19 pandemic (Office of the Permanent Secretary, 2020, p. 26).

[7] Weaver, mat weaver, miner, rubber, tapper, sugar maker/palm tree climber, scavenger, carpenter, wicker maker, brick maker, vegetable gardener, mushroom cultivator, salt farmer, carver, merchant, rancher, fisherman/aquaculture raiser, civil official/ state enterprise employee, and others had less than 0.1% of internet traffic.

C. National Statistical Office Survey 2018

In July-September 2018, the National Statistical Office (NSO) together with the Ministry of Digital Economy and Society (MDES) conducted a field survey to collect villager's opinions and satisfaction toward Net Pracharat covering some 2,577,231 persons in 24,700 villages located nationwide (55% from Northeast region, 17% North, 15% Central and 13% South). Most respondents were farmers (42%) followed by students (16%).

The survey data was made available by NSO for this assessment report. In this section, a brief overview of the data and logistic regression is conducted to verify and consolidate findings in the APT Report (2019) and the comprehensive Chiang Mai University Inception Report (2021).

As indicated in the APT Report (2019) about 73.5% (88.7 response rate) recognized the benefits of the Net Pracharat services in providing access to high-speed Internet, with about half saying that it helped promote and improve the quality of life of people in the village, as well as providing opportunities for earning a living, generate income supplement and facilitate the search for useful information related to health, agriculture, and education.

Cross correlation matrix using NSO survey 2018 data

	useNP	Female	Age	Education	Internet Access	Central	North	Northeast	South	Training	Useful
useNP	1.00										
Female	-0.04	1.00									
Age	-0.17	-0.02	1.00								
Education	0.08	0.01	-0.39	1.00							
Internet Access	0.13	0.01	-0.14	0.17	1.00						
Central	-0.04	-0.01	0.02	0.04	0.08	1.00					
North	-0.02	0.00	0.05	-0.04	0.04	-0.19	1.00				
Northeast	0.06	0.01	-0.04	-0.04	-0.13	-0.48	-0.52	1.00			
South	-0.03	0.00	-0.02	0.06	0.07	-0.15	-0.16	-0.41	1.00		
Training	0.35	-0.01	0.04	-0.01	0.09	-0.01	0.00	0.03	-0.03	1.00	
Useful	0.17	0.00	-0.06	0.05	0.11	-0.05	0.00	0.06	-0.04	0.15	1.00

Author's Calculations

where "useNP" is dummy variable 1 for using Net Precharat Internet (0 otherwise), "female" is 1 for female and 0 male, "age" is age groups (every 5 years), "education" is a 10 group education category, "Internet access" is 1 if have internet access and 0 otherwise, and regions are "central", "north", "northeast" and "south", "training" is 1 if received training for Net Precharat (0 otherwise) and lastly "useful" is 1 if they thought Net Precharat was useful and 0 otherwise.

The correlation matrix above shows that relatively more males and younger with higher education and already having access to Internet use Net Pracharat Internet, as well as those in the Northeast, and those having received training and finding Net Pracharat useful.

Logistic regression is applied to the NSO 2018 survey data where the sign of coefficients suggest correlation between usage and other variables of interest. The (binary) logistic regression is used by running "useNP" i.e. whether respondent used Net Precharat Internet or not as the dependent variable on a number of co-variates including female, age, education, whether respondent has Internet access, region, whether respondent received training and whether they found Net Pracharat services useful.

Logistic regression with "useNP" as dependent variable:

useNP	Coef.	Robust Std. Err.	z
female	-0.22	0.00	-54.49
age	-0.15	0.00	-183.70
education	0.01	0.00	8.15
Internet access	0.40	0.00	92.13
north	0.11	0.01	15.90
northeast	0.29	0.01	49.19
south	0.04	0.01	5.62
training	1.63	0.00	365.69
useful	0.80	0.01	120.71
constant	-0.84	0.01	-63.80

Author's Calculations

The logistic regression confirms that male and the younger tend to use Net Pracharat services relatively more. Also, those who already had access to Internet, had received training on how to use Net Precharat and those who found it useful tend also to use the Net Precharat services more. Lastly, the regression confirms that villages in the Northeast region of Thailand tend to use Net Precharat services more than other

regions in the country. Note however that only 38.5% of respondents say they have used Net Pracharat Internet.

Overall, 70.1% of respondents are aware of whether Net Pracharat was installed in their villages or not, from government sources (including village elders, NPCR trainers, etc.), but perhaps because the survey was carried out during the early stages of the Net Precharat project, only 38.5% (70% response rate) say that they have actually used Net Pracharat services at least once. Also, more than 86% thought that more numbers of public Wi-Fi hotspots should be installed throughout their villages.

Furthermore, of 62.6% of those who responded, 29.3% report that that received training for Net Pracharat, while 40.4% did not and 30.3% were not aware about any kind of training. Many thought that Internet services are important for counselling on medical treatment (21.4%) followed by providing knowledge about agriculture (15.1%) and career promotion and development (11.4%).

Given that the 2018 survey was carried out very early into the project (just after the implementation of Net Pracharat), there is further need to perform a follow up in-depth analysis with additional empirical evidence of the project's results and impacts.

D. Chiang Mai University Inception Report (2021)

The CMU Inception Report (June 2021) provides another comprehensive analysis of Net Pracharat, focusing on achieving objectives in developing (1) infrastructure, (2) institution, and (3) behaviour.

The report is based on a separate survey of 1,598 villages completed in May 2021, comprising 820 villages equipped with high-speed internet of Net Pracharat Internet project (Remote (Zone C) consisted of 639 villages, and Universal Service Obligations (USO) border areas (zone C+) project, amounting to 138 villages).[8]

The Report distinguishes four objectives regarding the efficiency and effectiveness assessment of Net Pracharat in providing telecom and social services, namely:

Obj. 1. All people, including in rural areas, can access basic telecom services at reasonable prices. Assessment (telecom access): USO Zone C = 29.47 persons/spot, USO Zone C+ = 43.10 persons/spot with increasing trend of 2.87 and 5.16 persons/spot during collection process compared to beginning

[8] The CMU report (2021, p. 25) states that only data on survey of 718 villages (48% of targeted villages) were digitized and analysed.

Rating Survey (7.86 points overall)

- Satisfaction on overall internet service
- Opinion on free hi-speed internet access
- Satisfaction on government's hi-speed internet network investment policy
- Feelings about the worth of government's investment

Obj. 2. All people can access to information equally nationwide Assessment (information access):

Rating survey (points for Zone C / C+)

- Equal information access (7.94 / 7.84)
- Increasing potential for making career, revenue, education, healthcare, agriculture, online trading (7.75 / 7.69)
- Solving problems with new solutions and having innovation (5.81 / 5.93)

Obj. 3. Reduce gap/inequality of information access and communication (digital divide) Assessment (digital divide):

- If there's no internet access from other source, 78.5% of people in Zone C and 80.3% from C+ will use the project's internet
- "gov't should invest more in hi-speed internet" (C / C+): 8.49 / 8.27 points
- "gov't should use budget to increase hotspots" (C / C+): 65.4% / 63.4%

Main Conclusion: The Net Pracharat Project helped reduce the digital divide by providing internet access to the disenfranchised and disconnected.

Obj. 4. Establish school, community, and social internet centres under the name "**USO Net Centre**" to allow access for disconnected organisations.

From the overall scores, it may be concluded that the **USO Net** services achieved its goals effectively.

Furthermore, the CMU Inception Report (June 2021) employed several techniques, such as:

(1) Net Present Value (NPV) & Benefit-Cost Ratio (B/C Ratio) & Internal Rate of Return (IRR),
(2) Social Accounting Matrix (SAM) & Computable General Equilibrium (CGE),
(3) Social Return on Investment (SROI), and
(4) various econometrics methods especially Structural Equation Modelling (SEM).

The CMU Report also provides details through a **cost-benefit analysis:**

Calculating Net Present Value (NPV) & Benefit-Cost Ratio (B/C Ratio): No payback on investment by calculating only from the economic benefits people received. But this is to be expected, since the project is not designed for profit.

Internal Rate of Return (IRR): 62.04 (Only positive NPV are computed, i.e., when there are Net Pracharat users exceeding 600,000 persons/day)

Indicators for efficiency assessment:

- New Users Per Investment (NUPI): # of people who never had access to internet prior to this project
- Better Quality Per Investment (BQPI): # of people who used lower quality internet before this project
- Total Access Investment (TAPI)
- Digital Divide Alleviation (DDA): # of people who can access internet via the project compared to total Thai population

Table 2: Efficiency Indicator from Cost-Effectiveness Analysis

Index	Net Pracharat	USO (Zone C)	USO (Zone C+)	All Projects
NUPI (person/1M baht)	144.02	25.39	71.86	65.17
BQPI (person/1M baht)	229.19	49.26	127.74	113.23
TAPI (person/1M baht)	1,091.07	251.35	671.58	561.81
1st DDA value	16.47	7.75	9.69	33.92

Source: CMU, 2021, p. 217

Social Accounting Matrix (SAM) & Computable General Equilibrium (CGE) measured the following:

(1) the total effect from investment (direct, indirect, induced),
(2) benefits on the economic sector,
(3) benefits on households from income distribution,
(4) nominal/real GDP growth rate and value, and
(5) benefits on tax collection.[9]

[9] It was found that the Net Pracharat and USO is a worthy economic investment that benefits the production sector, households and the government. For the project improves the people's livelihoods, especially low-income households, strengthens the digital economy and helps drive the nation’s GDP and tax revenue through more investments.

The Social Return on Investment (SROI)

Table 3: Return on Investment Calculation by ROI and SRO

User Range	Net Pracharat	USO (Zone C)	USO (Zone C+)	All Projects
SROI (at most)	9.17	1.35	0.74	3.16
SROI (at least)	2.61	0.36	0.21	0.89
ROI (at most)	2.56	0.20	0.18	0.78
ROI (at least)	0.96	0.07	0.07	0.29

Source: CMU, 2021, p. xxiii

Calculating SROI (economical & social return) and ROI (only economical return)

- Each index in 2 cases: at most (600,000 users/day) / at least (400,000 users/day)
- SROI/ROI > 1 means investment has met payback point

The study, in only considering economical returns, all projects has not met the payback point yet except Net Pracharat if there are 600,000 users/day (ROI=2.56)

It was also determined that if there are 400,000 users/day, overall SROI=0.89 / ROI=0.29, Net Pracharat had the highest SROI and is the only project that met its payback point in 2021 at SROI=2.61.

The payback period (all projects) is summarized below:

Table 4: Payback Period

User Range	All Projects
Sooner payback period based on SROI	Already had payback since 2019
Later payback period based on SROI	2022
Sooner payback period based on ROI	2022
Later payback period based on ROI	2040

Source: CMU, 2021, p. xxiii

- SROI sooner case: already may have met payback point in 2019 if there were 1.07M users/day
- SROI later case: payback in 2022 if there are 400,000 users/day
- ROI sooner case: payback in 2022 if there are 1.07M users/day
- ROI later case: payback in 2040

Further analysis showed that there was greater economic impact when considering certain user attributes. This includes aspects such as their monthly income (which was determined to have the most economic impact), telecom service consumption behaviour, occupation, and service area whether USO zone C, or USO Net. It was reported that a 1% change of these factors affected the probability of economic impact by 0.014-0.415%, and the factors with largest effect are retired and medical personnel, respectively.

Moreover, it was shown that change in telecom service consumption behaviours affected the probability of economic impact. These telecom service consumption behaviours include individual experiences in using the Internet before USO, use of USO for longer and continuous connectivity, for publishing of digital content, and for other purpose. The user's satisfaction was also considered and encompassed opinions toward government investment in the Internet, ease of registration and use, accessibility, overall quality, internet use for stress relieve, and service area. With this it was determined that a 1% change to these factors affect the probability of economic impact by 0.015-0.358%, and the largest effects are those of one's experience using the internet before USO and USO Zone C+, respectively.

Lastly, in considering factors that affect the social impact of the project, user attributes and telecom service consumption behaviours were accounted for. On one hand, user attributes refer to an individual's monthly income, social status, educational attainment, etc. Telecom consumer behaviour, on the other hand, include the individual's experience in using USO, such as using it as an alternative to other services, use for long and continuous connection, for publishing digital content and other purpose. Aside from this, the report also measured the user's satisfaction toward government investment in the Internet, ease of registration and use, accessibility and simplicity, overall quality, and service area (USO Zone C+, subdistrict hospital WiFi). With these considered, the report determined that a 1% change to these factors affect the probability of social impact by 0.039-1.030%, and the factors with the largest effect are individual uses for personal contact and for creating income channels, respectively.

Further, the Structural Equation Modelling (SEM) reveals that creating dependent variables to reflect social impact from utilising Net Pracharat and USO internet for information access, interpersonal communication, and entertainment (telecom service consumption behaviour) are related to the interest in using Net Pracharat and USO internet in the future for those who have never used it before. The main results are shown in the social impact model. The study found that factors with positive relationship with social impact are those of increased income, no experience in using internet, using better internet quality, have

adequate ability to use the internet. While factors with negative relationship are those of increased age, inability to search or access to information via the Internet, inability to classify between fact and false information, and having no new solutions for problem solving or creativity from using internet.

IV. Proposed Assessment Framework

A. Research Design and Methodology

There are several standard models to access policy initiatives and their impact.[10] For a proper social-economic impact evaluation of Net Pracharat, it is proposed that the assessment use both qualitative and quantitative methods. Namely, focus groups studies as those conducted in the APT Report[11] involving structured questionnaires and interviews with all stakeholders and villagers. This should be paired with a quantitative study for impact evaluation through an extensive survey and cross-referenced with existing data.

More specifically, we propose a mixed-research method, comprising of the following qualitative and quantitative methods:

Qualitative methods

I. A comprehensive survey
II. Focus-group interviews

Quantitative methods

I. Validation of CMU survey results
II. Difference-in-differences estimation
III. Propensity score matching (Optional)

B. Qualitative Methods

A survey and focus group study should assess Net Precharat project's socio-economic benefits covering (1) e-commerce/business, (2) education (3) public health services, (4) agriculture, and (5) e-government services, with specific focus on (1) accessibility of basic services and information, (2) reducing gap/inequality of information access and communication (digital divide), (3) accessibility for disconnected organizations (school, community, social internet centers, etc.), and so on.

[10] Gertler et al. (2016).

[11] Which include (1) Baan Nong Klong Village, Sing Buri Province, (2) Baan Ta Sumrong Village, Chai Nat Province, and (3) Wat Jun Village, Nakhon Si Thammarat Province.

I. A comprehensive survey (N=400)

The following are sample questions for selected villages with access to the Net Pracharat Internet and services. (A sample of N = 400 is recommended).

1. Has helped me sell new products using the same channel
2. Has helped me find new ways of enhancing my skills at work (indirect economic benefit)
3. Has increased my existing business/work/job opportunities
4. Has increased my new business/work/job opportunities
5. Has increased the geographical reach of my business (customer/suppliers) than before/ Increased my professional circle as I am more connected
6. Has reduced my travel time to and from business/work-related activities
7. Has helped me in searching for new information related to business/work
8. Has intensified competition/ I feel competitive pressure
9. Has helped me conduct my business/work-related transactions efficiently (deal with more people in the same amount of time)
10. Has increased the number of customers/suppliers for my business / number of professional contacts that I need to be in touch with for work
11. Has helped in searching information on topics related to Business/work
12. Has helped me in collaborating with others for business/work
13. Has reduced my waiting time for business/work-related activities
14. Has brought down the cost of my supplies as I get competitive rates from different vendors/brought down my work cost as I get accurate information from the Internet related to my work (I spend less time so there is less work cost)
15. Has increased the number of people who can help in improving my current ability to earn
16. Has helped viewing videos for learning and understanding something in a better way
17. Has helped searching and understanding the subjects that I would not have been able to understand otherwise
18. Has helped in getting a chance to talk to other people who are interested in the same topics I am interested in
19. Has enabled me to be in touch with my friends and has increased my social interactions
20. Has increased my knowledge of welfare and the whereabouts of friends & relatives outside the city
21. Has increased my interactions with my relatives/friends (through emails/social networking sites etc.)

22. Has helped in understanding the linkage among related topics better because of the Internet
23. Helped in exchanging ideas about work with other people
24. Has made it easy for me to stay in touch with relatives/friends
25. Has helped in becoming more confident in my work requirement/job role
26. Has helped in getting accurate information
27. Has helped in delivering work duties and responsibilities without being physically present at the place of work
28. Has increased the number of people who I can turn to in case of an emergency
29. Has helped in banking online for business/work-related transactions /conducting online transaction (booking railway, airline, bus etc./shopping for clothes/shoes/electronic items/books etc.)
30. Has helped in Getting feedback on business/work-related issues

II. Focus-group interviews

Figure 5: Stakeholders of the Net Pracharat Project

Source: APT Report, 2019, p. 16

Regarding stakeholders (especially MDES, TOT, NBTC, Ministry of Interior, Village leaders, etc.), it would help assessment if precise direction and objectives of the Net Pracharat are identified.

More specifically, sample questions for stakeholders are as follows:

1. Main objective(s) that Net Pracharat should address.
2. Are they technologically capable of providing sufficient broadband capacity to all villages to allow Net Pracharat targets to be met?
3. Would it be financially viable for private network operators to provide connectivity via new rural terrestrial wireless broadband technologies?
4. What economic and social benefits could potentially be obtained by authorizing these technologies?
5. What are expected additional revenues for villagers, which sets a target of offering broadband access to rural users?
6. How often does MDES conduct activities such as (a) promoting local community business to become E-Commerce villages, (b) expand Net Pracharat Volunteer network, (c) form provincial Net Pracharat caretakers, and (d) organize Net Pracharat Village Model contest.
7. What are the objectives and expected benefits of activities in (6) above?

C. Quantitative Methods

In terms of quantitative impact evaluation tools, further field research, especially using control groups are desirable, namely: (1) **difference-in-difference methods (DID)** and/or (2) propensity score matching (PSM). Since a randomized control trial (RCT) was not initiated at the beginning of the project, the above DID and PSM should provide a more definite quantitative assessment.[12] Furthermore, it is useful to measure perceived impact of Net Pracharat users by age, gender, digital literacy, (household) earnings, education, occupational groups, as well as on empowerment, work, and transaction efficacy.

I. Validation of CMU survey results

The 2021 CMU report used only about half of data collected (only about half of data collected were digitized for their report). Hence it would be useful to repeat/re-check important results of the CMU report, especially regarding (1) Net Present Value (NPV) & Benefit-Cost Ratio (B/C Ratio) & Internal Rate of Return (IRR), (2) Social Accounting Matrix (SAM) & Computable General Equilibrium (CGE), (3) Social Return on Investment (SROI), as well as (4) various econometrics methods employed including Structural Equation Modelling (SEM).

[12] Further description of these techniques will be provided as required. Also see Gertler et al. (2016).

II. Difference-in-differences estimation

The difference-in-differences method compares the changes in outcomes over time between a population that is enrolled in a program (the treatment group) and a population that is not (the comparison or control group). In the Net Pracharat case, for example, access to broadband Internet is carried out at the village level (but is not randomly assigned between villages but rather whether areas (remote/rural) had access to the Internet or not. The village people then decided to enrol or not enrol in the program. One of the program's objectives is to improve access of the Internet and a corresponding socio-economic outcome indicators could be the employment rate, for example.

Simply observing and comparing the before-and-after change in the socio-economic outcome (say, employment rates) for villages members that enrol in the program will not capture the program's causal impact because many other factors are also likely to influence employment over time. At the same time, comparing those villages that enrolled and did not enrol in the Net Pracharat program will be problematic if unobserved reasons exist for why some people enrolled in the program and others did not (this is referred to in the literature as a selection bias problem).

However, if we combine the two groups (referred to in the literature as the treatment and control groups) and compare the before-and-after changes in outcomes for the group that enrolled in the program (treatment group) with the before-and-after changes for the group that did not enrol in the program (control group), the difference in the before-and-after outcomes for the enrolled group (the first difference) then controls for factors that are constant over time in that group, since we are comparing the same group to itself. But we are still left with the factors that vary over time (time-varying factors) for this group. The trick to capturing those time-varying factors is to measure the before-and-after change in outcomes for a group that did not enrol in the program but was exposed to the same set of environmental conditions (the second difference).

Hence, if we "clean" the first difference of other time-varying factors that affect the outcome of interest by subtracting the second difference, then we have eliminated a source of bias that worried us in the simple before-and-after comparisons. The difference-in-differences approach does what its name suggests. It combines the two counterfeit estimates of the counterfactual (before-and-after comparisons, and comparisons between those who choose to enrol and those who choose not to enrol) to produce a better estimate of the counterfactual. In the example of the road repair program, the DD method might compare the changes in employment before and after the program is implemented for individuals living in villages enrolled in the Net Pracharat program with the changes in employment in villages that did not enrol in the program.

Figure 6: Difference-in-differences Method

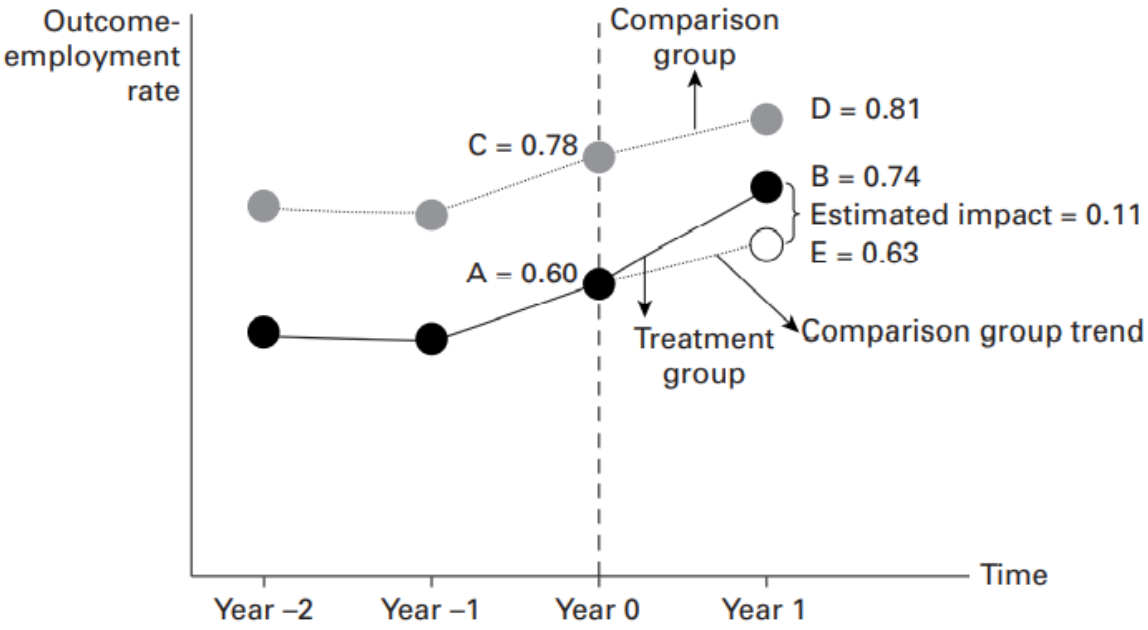


Figure 6 illustrates the difference-in-differences method. Year 0 is a "baseline" year. In year 1, a treatment of villages people enrols in the program, while a comparison or control group is not enrolled. The outcome level (employment rate) for the treatment group goes from A, before the program starts, to B after the program has started, while the outcome for the comparison group goes from C, before the program started, to D, after the program has started.

The difference in outcomes before and after the intervention for the treatment group (B – A) and the difference in outcomes after the intervention between the treatment and comparison groups (B – D) can be easily calculated. In difference-in-differences, the estimate of the counterfactual is obtained by computing the change in outcomes for the comparison group (D – C), and then subtracting this from the change in outcomes for the treatment group (B – A). Using the change in outcomes for the comparison group as the estimate of the counterfactual for the change in outcomes for the treatment group is akin to assuming that, had the enrolled group not participated in the program, their outcome would have evolved over time along the same trend as the non-enrolled group: that is, the change in outcome for the enrolled group would have been from A to E, as shown in the figure above.

In summary, the impact of the program is simply computed as the difference between two differences. That is, for our hypothetical example:

DD impact = (B – A) – (D – C) = (0.74 – 0.60) – (0.81 – 0.78) = 0.11.

In sum, the difference-in-differences method computes the impact estimate as follows:

1. Calculate the difference in the socio-economic outcome (Y) of interest between the before and after situations for the treatment group (B – A).
2. Calculate the difference in the outcome (Y) between the before and after situations for the comparison group (D – C).
3. Then we calculate the difference between the difference in outcomes for the treatment group (B – A) and the difference for the comparison group (D – C), or difference-in-differences (DD) = (B – A) – (D – C). This difference-in-differences is our impact estimate.

Although for difference-in-differences to be valid, the comparison group must accurately represent the change in outcomes that would have been experienced by the treatment group in the absence of treatment, the treatment and comparison groups do not necessarily need to have the same conditions before the intervention. To capture time-varying factors as well as sample selection, for example, because the Net Pracharat was targeted to rural/remote areas, simple differences may not work. That is, if treatment villages also benefit from the fact that they are targeted at the same time as having access to Net Pracharat services, we will not be able to separate out the effect from Net Pracharat and from "being targeted" using the simple difference-in-differences approach measure described above.

To "fix" this problem, we can directly estimate the socio-economic impact using a regression framework. The advantage of this is that we can control for other (time-varying) variables as well as use methods to solve selection-bias. We also get the treatment intensity (e.g. varying increases in employment for different villages) and we can also include multiple time periods into the analysis. The typical regression model we estimate is:

$$\begin{aligned}\text{socio-economic indicator} &= \alpha + \beta_1 Dummy^{post} + \beta_2 Dummy^{treatment} \\ &= \quad +\gamma(Dummy^{post} \times Dummy^{treatment}) + \sum_k \phi_k Controls_k + \epsilon\end{aligned}$$

where the dependent variable is the socio-economic indicator of interest (e.g. employment, education, health, poverty, etc.), $Dummy^{treatment}$ is an indicator variable whether the unit is in the treatment group or not, $Dummy^{post}$ is post-intervention dummy, and Controls are a set of time-

varying controls (e.g. average village income, etc.) The coefficient of interest for the difference-in-differences is γ, the coefficient for the interaction variable ($Dummy^{post} \times Dummy^{treatment}$).[13]

III. Propensity score matching (Optional)

Depending on data availability, the method of matching or propensity score matching (PSM) can also be applied. Matching essentially uses statistical techniques to construct an artificial comparison group. For every possible unit under treatment, it attempts to find a non-treatment unit (or set of non-treatment units) that has the most similar characteristics possible. Finding a good match for each program participant requires approximating as closely as possible the characteristics that explain that individual's (or village) decision to enrol in the program. Unfortunately, this is easier said than done. If the list of relevant observed characteristics is very large, or if each characteristic takes on many values, it may be hard to identify a match for each of the units in the treatment group. As you increase the number of characteristics or dimensions against which you want to match units that enrolled in the program, you may run into what is called the curse of dimensionality.

Fortunately, the curse of dimensionality can be quite easily solved using a method called propensity score matching.[14] In this approach, we no longer need to try to match each enrolled unit to a non-enrolled unit that has exactly the same value for all observed control characteristics. Instead, for each unit in the treatment group and in the pool of non-enrolled, we compute the probability that this unit will enrol in the program (the so-called propensity score) based on the observed values of its characteristics (the explanatory variables). This score is a real number between 0 and 1 that summarizes the influence of all of the observed characteristics on the likelihood of enrolling in the program.

Once the propensity score has been computed for all units, then units in the treatment group can be matched with units in the pool of non-enrolled that have the closest propensity score. The average difference in outcomes between the treatment or enrolled units and their matched comparison units produces the estimated impact of the program. In summary, the program's impact is estimated by comparing the average outcomes of a treatment or enrolled group and the average outcomes among a statistically matched subgroup of units, the match being based on observed characteristics available in the data at hand.

[13] See Card and Kreuger (1994) for more details.

[14] See Rosenbaum and Rubin (1983).

D. Timeline and Manpower Requirements

The following timeline is proposed for the comprehensive/consolidating research for national socio- economic impact assessment of the Net Pracharat. Approximately 3 months would be suitable, engaging 5 researchers (including one principal researcher), for the follow up assessment starting from setup and pre-operations and planning to actual field survey, data analysis and report presentation.

SPECIFICS	Month 1	Month 1	Month 2	Month 2	Month 3
Setup, pre-operations, and planning	20 days				
Finalization of socio-economic assessment framework and tools	20 days				
Stakeholder meetings, interviews		10 days	20 days		
Field survey (selected villages), focus group interviews			20 days	10 days	
Data analysis, prepare reports and presentations				10 days	20 days

It is recommended that that survey cover N=400 respondents, while the stakeholder meeting/interviews should include them main government agencies and a number of village heads, users of Net Pracharat and volunteers (the exact numbers to be determined). For Diff-in-Diff (and PSM), data from NSO for post-treatment period would be useful if available, otherwise N=1000 survey is recommended (possibly to match CMU study).

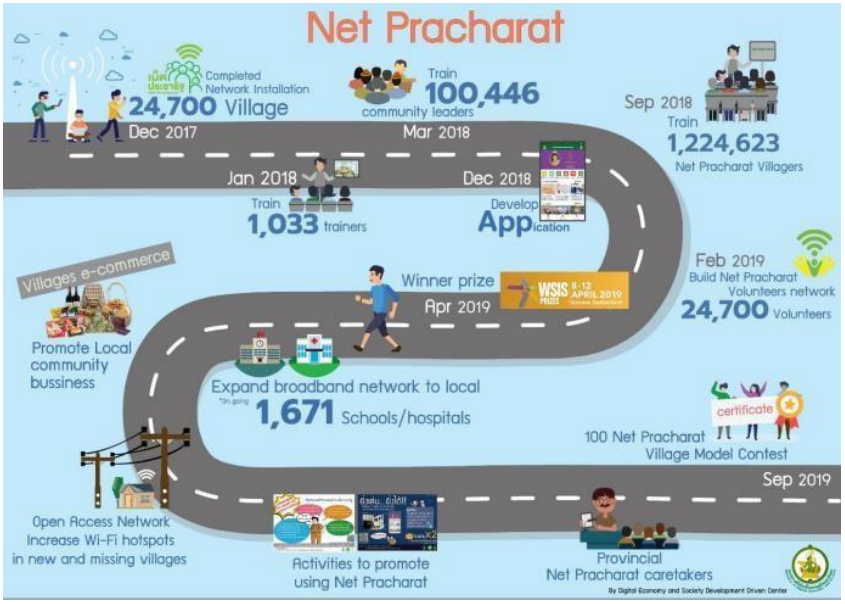
Since most of the studies were done before the outbreak of the global pandemic, it is important to re-examine the socio-economic impact of Net Pracharat to cover the pandemic period. Although, direct comparison with pre-pandemic period may be misleading, it will be interesting to understand the benefits accrued by villagers connected to Net Pracharat during the COVID-19 pandemic, such as access to timely information, healthcare services, e-government services, and benefits to business, social communication, education and so on.

V. Concluding Remarks

As the flagship digital infrastructure development project of Thailand, the Village Broadband Internet Project or Net Pracharat has come a long way since its inception. It has facilitated the installation of fiber optic cable networks for thousands of target rural villages throughout the country guided by the goal of enhancing Thailand's telecommunication infrastructure. This would decrease conditions of inequality for people in the targeted villages and provide more opportunities for them to

access public services for a better quality of life. Moreover, it would also bolster the locale's economic and social potential through career building, income generation, and access to education, public health, agriculture, and online trading services. As the rural areas become increasingly commercially viable, the Net Precharat project could become an important source of government revenue through increased taxes on new businesses and economic activities generated both directly and indirectly by the Net Precharat project.

Figure 7: Road Map of the Net Pracharat Project



Source: APT Report, 2019, p. 53

According to the roadmap shown above, MDES reports that it is expanding the Net Pracharat network by installing fibre optic cable networks to reach rural schools and hospitals nationwide. Additionally, to promote infrastructure sharing, MDES plans to open the Net Pracharat network based on an Open Access Network (OAN) model. This would allow any telecommunication service provider who obtained a telecommunications license to connect to the Net Pracharat network without fees to internet services to last mile households and customers at fair and affordable prices.

However, despite much progress, a comprehensive up-to-date assessment of the socio-economic impact of the Net Pracharat remains somewhat absent. With so much invested in the project, there is need to conduct a proper scientific assessment of the Net Pracharat, its socio-economic benefits, barriers, costs, and opportunities for development.

For a proper impact social-economic evaluation of Net Pracharat, the use of both qualitative and quantitative methods is proposed. Namely, a comprehensive questionnaire to capture impact/benefits/costs of Net

Pracharat for users in villages, covering (1) Economic/business Impact, (2) education/learning, (3) social/communication, (4) health services, and (5) e-government (incl. issues related to Covid-19). Also focus groups studies involving structured questionnaires and interviews with all stakeholders and villagers, which should then be paired with a quantitative study for impact evaluation which should also be cross-referenced with existing data. The main policy impact tool suggested is the difference-in-differences estimation method to quantify the socio-economic impact of Net Pracharat.

References

ADB Institute (2018). Understanding the Digital Economy: What Is It and How Can it Transform Asia?

APT Report on Best Practice of Connectivity. (2019). Village Broadband Internet Project (Net Pracharat) of Thailand. Asia-Pacific Telecommunity.

Card, D. and Krueger, A. (1994). Minimum wages and employment: A case study of the fast-food industry in new jersey and pennsylvania. *American Economic Review*, 84, 772-793.

Chiang Mai University (2021) **รายงานผลการศึ กษา** [Inception Report]

Gertler, P. J., Martinez, S., Premand, P., Rawlings, L.B., & Vermeersch, C.M.J. (2016). *Impact Evaluation in Practice* (2nd ed.). Washington, DC: Inter-American Development Bank and World Bank. https://openknowledge.worldbank.org/handle/10986/25030

International Telecommunication Union. (2020). The Last-mile Internet Connectivity Solutions Guide: Sustainable Connectivity Options for Unconnected Sites.

Ministry of Digital Economy and Society. (2016). National Broadband Network Development Plan, Bangkok: Ministry of Digital Economy and Society.

National Statistical Office and Ministry of Digital Economy and Society. (2018). รายงานผลการสำรวจ ความคิดเห็นของประชาชนที่มีตอโครงการเน็ตประชารัฐ พ.ศ. 2561 (หลังการดำเนินการติดตั้งโครงขายอินเทอรเน็ตประชารัฐ) [Survey of people's opinions towards the Net Pracharat Internet Project 2018]

Office of the National Economic and Social Development Board. (2018). National Strategy 2018- 2037

Office of the National Economic and Social Development Board. (2017). The Twelfth National Economic and Social Development Plan (2017-2021).

Office of Permanent Secretary. (2020). The Internet Use of Net Pracharat Villages Report: January to June 2020. Digital Economy and Society Development Driven Center.

Prasertpakdi, N. (2018). Saan Palang Pracharat [Collaborate Pracharat Power]. Bangkok: The Secretariat of The House of Representatives Print.

Rekha, J. (2016). Measuring the perceived impact of Internet on individuals in rural India. Working Paper-Indian Institute of Management, Ahmedabad (2016-03-61).

Rosenbaum, Paul, and Donald Rubin (1983). The Central Role of the Propensity Score in Observational Studies of Causal Effects. *Biometrika*, 70(1). 41–55.

Saan Palang Pracharat [Collaborate Pracharat Power]. Bangkok: The Secretariat of The House of Representatives Print.