Internet Journal of Society for Social Management Systems
ISSN:
ORIGINAL ARTICLE

Thailand Recent Drought Counter Measure Program Assessment

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***Abstract*:** In the recent years, Thailand had suffered from both floods and drought which caused huge damages to the country's socio economics. Water management in the country has different characteristics by area due to the topographical, meteorological and water demand conditions, e.g. , low land area in the central plain (with 6 dams and annual rainfall of 1100-1500 mm) which make each irrigation dam operation rule different to supply water for domestic, industrial and irrigation especially in the drought period. Many drought counter measures had been taken to mitigate drought loss in the past years which needs to be assessed its effectiveness.

The study investigated the counter measures taken for drought management during 2014/2015 and 2015/2016 in basin scale and in 2017 in the case study area. The field survey on farmer adaptions were conducted and reviewed in the central plain of Chao Phraya Basin where main paddy activities were located. The effect of drought counter measures was also surveyed from the farmers in the study area. The drought counter measure program of both periods was then assessed based on the World Bank Approach to see the effectiveness of counter measures conducted during these two drought periods in both study area and case study area.

The study found that drought counter measures in 2015/2016 were improved much and to be more proactive from measures in 2014/2015 and more integrated in 2017.Farmers adapted better with more information and supportive measures both in the study area and case study area though there are still some improvements needed, especially active public participation based on WB approach.

Keywords: drought, farmers, counter measures, assessment

1. Introduction

Thailand suffered from the big floods in 2011 and has faced with the consecutive droughts during 2014-2016. Such events caused huge damages to the socio-economic condition of the country. Water management in the country has different characteristics by area due to the topographical, meteorological and water demand conditions particularly for rice cultivation, e.g. , wet area in the central plain (with 6 dams and annual rainfall of 1100-1500 mm) which make the different rules of dam operation. Many drought counter measures had been taken to mitigate drought loss in the past years including groundwater supplementary provision

Received: / Accepted:
Internet Journal of Society for Social Management Systems Published Date:

which needs to be assessed its effectiveness.

The drought counter measures were implemented and improved during drought periods in 2014/2015 and 2015/2016 and an integrated measures in the low land area in 2017. The paper presented the assessment of drought counter measure program taken during these two drought events to find the effectiveness of the counter measures and future improvement based on WB approach.

Normally, the contingency plan will be prepared to counter with drought and the process will cover the contingency planning process, guidelines and evaluation to be set at the national government and inter-agency levels. Recently, there was a review on the benefits of action and costs of inaction of drought mitigation and preparedness (Nicolas Gerber et. al., 2016). Some studies on loss assessment had been conducted in NE Thailand for drought crisis (Koshi Yoshida, et al, 2019).

In the study area, the study of impact of climate change to irrigation system had been conducted in various types of irrigation projects, dam and regional operations (Chulalongkorn University and RID, 2010: Sucharit K., 2013) and in the basin planning in the Nan River Basin (Sucharit K., 2012). The use of groundwater as supplementary water for irrigation in the dry years was also explored (Sucharit K, 2015). The government had set the water resources management long term master plan (2015-2026) to provide water supply to villages and cities, to reduce water disaster risk, to improve water quality in the natural streams, to foster integrated water management scheme, and to improve water management structure of the central functions and community level (Ladawan Kampa, 2016). Besides, the country is now committed with UN's SD policy and has set goals within SDG framework including water sector.

2. Study area

The study selected the central plain area as the study area due to the importance of socio-economic development of the country for rice cultivation especially in the dry season and Bang Rakam area as integrated case (as shown in Figure 1). The land use in the study area comprised of solely agricultural land in the upper reach, urbanization with industry in the mid reach and urbanization, industry and service sectors in the downstream reach as shown in Figure 2.

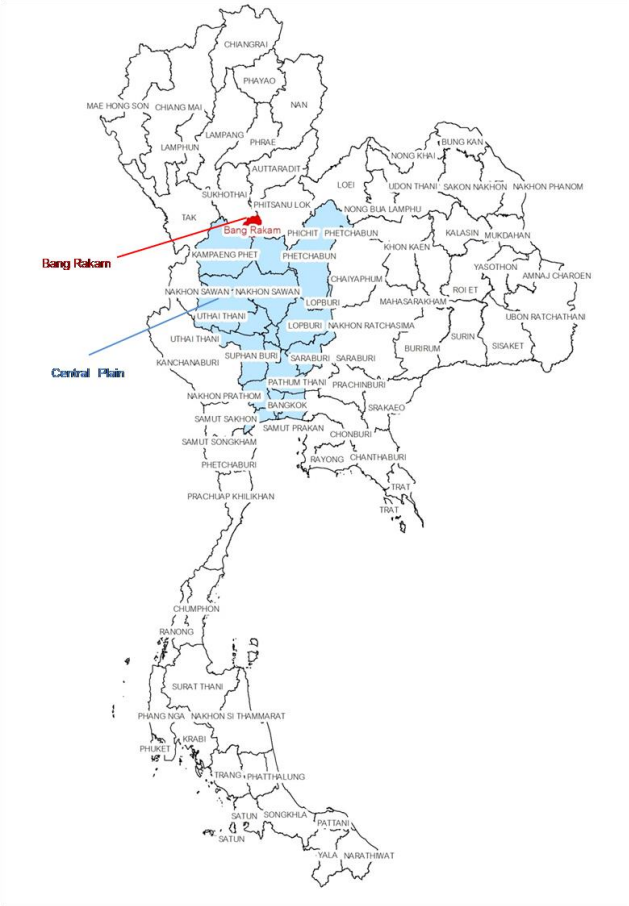


Figure 1 Locations of study and case study areas

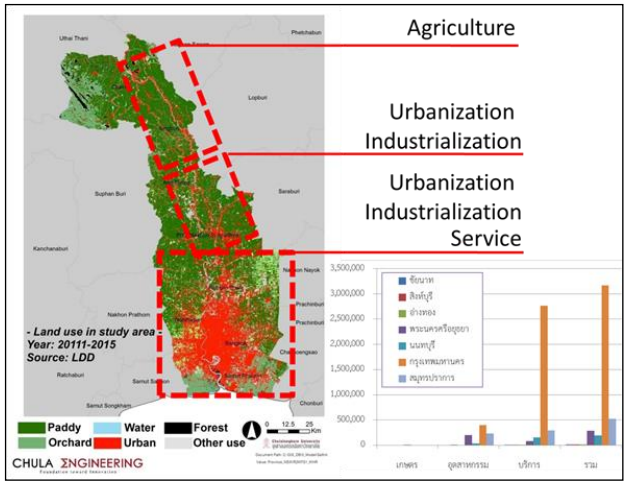


Figure 2 Study area and its land use distribution

3. Objectives and approach

The objectives of the study are set as follows:

1. To investigate the hydrological change during the year 2014-2016,
2. To assess the impact of drought management measures,
3. To assess the measures effectiveness based on WB approach,
4. To recommend future improvement based on WB approach.

The assessment is based on the concept of Integrated Drought management with "active response way" (shown in Table 1). In the study, the hydrological data were collected with dam operation to analyze the fluctuations of rainfall and dam operation during 2000-2016. The salt intrusion and flow discharge in 2015 was selected to show the effect of salt intrusion in the downstream reach. The assessment of drought counter measures in the years 2014/15 and 2015/16 were conducted via reviewed field questionnaires. Future improvement recommendations were made based on WB's Integrated Drought Management Approach (Nicolas G., Alisher M., 2017).

Table 1 Integrated Drought Management Approach

1. Monitoring and forecasting/ early warning	1.1 Foundation of drought plans
	1.2 Indices/indicators linked to impacts and action triggers
	1.3 Feeds into the development/delivery of information and decision support tools
2. Vulnerability/ resilience and impact assessment	2.1 Identifies who and what is the risk and why
	2.2 Involves monitoring/achieving of impacts to improve drought characterization
3. Mitigation and response planning and measures	3.1 Pre-drought programs and actions to reduce risks (short and long terms)
	3.2 Well defined and negotiated operational response plan for when a drought hits
	3.3 Safety net and social programs, research and extension
4. Proactive response way	4.1 Needs of systematic proactive approach
	4.2 Socio-economic losses must be considered, but also global water security and ecological resilience, not only economic analysis
	4.3 Drought monitoring activities need improvement and coordination
	4.4 Need for more capacity building, knowledge transfer, data sharing and more access to information for community involvement

4. Results

Rainfall data (rainfall amount and rainy days) during the year 2000-2016 were collected and shown in Table 1. It can be seen that during 2014-2016, the rainfall amount and rainy days declined and faced with drought periods. Meteorological patterns at two main dam sites in the study area also showed more fluctuations of rainfall pattern and dam storage (as

shown in Figure 3). The effect of low discharge from the dam release also induced salt intrusion in the downstream at the main water supply canal (with salt content above 0.25 mg/l, set as water quality limit for raw water supply) in the year 2014 as shown in Figure 4.

Table 2 Rainfall data and raining days during 2000-2016

Year	Rainfall (mm)		Rainy (days)	
	Central plain	National average	Central plain	National average
2000	1616	1787	131	140
2001	1497	1682	129	139
2002	1442	1586	122	132
2003	1252	1335	153	173
2004	1037	1258	136	165
2005	1172	1298	149	166
2006	1348	1610	164	186
2007	1246	1379	150	166
2008	1388	1525	160	179
2009	1635	1608	126	130
2010	1644	1677	126	133
2011	1499	1736	163	185
2012	1649	1730	148	148
2013	1638	1763	126	131
2014	1354	1570	113	122
2015	1429	1430	109	117
2016	1338	1355	144	160
Average	1423	1549	138	151

Source: Agricultural Economic Office (2016), Agricultural Statistics 2016, Ministry of Agriculture and Cooperatives.

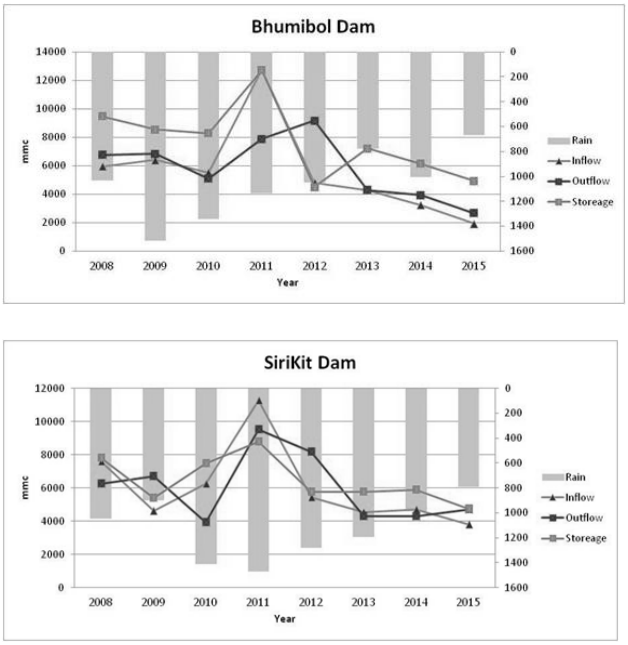
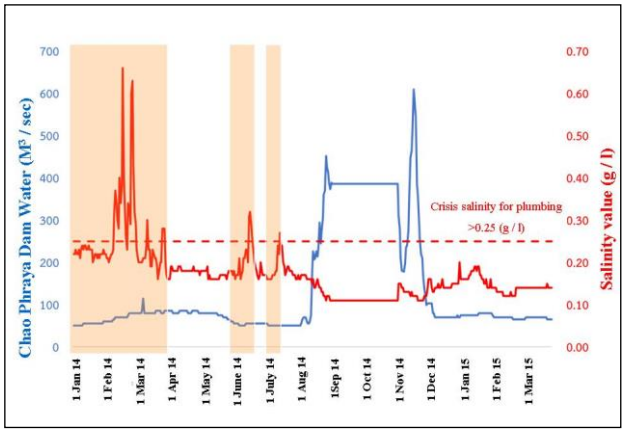


Figure 3 Fluctuation of meteorological conditions and main dam operations



Source: Royal Irrigation Department and Metropolitan Waterworks Authority

Figure 4 Fluctuations of Salinity in Chao Phraya River and upstream discharge from Chainart Diversion

In the drought 2014/2015, the government had issued counter measures by informing water situation to farmers, repair water infrastruces (such as gates etc.) for preparation and set the prior rule of water allocation before the drought and during the drought, the government seeked for additional water sources (such as excavated more ponds and/or digged more wells in the suitable locations) for farmers and also made campaign to plant suitable

crops instead of paddy.

However in the drought 2015/16, more comprehesive drought counter measures were prepared, i.e., M1: Promotion of knowledge, cost down and change to other crops (campaign for substitute crop and cheap household supplies provision), M2:Extension of rental fee and/or debt payment (rental fee compensation, special long term and soft loan provision), M3: Job creation or training: (road or water infrastructure repair works or training provision), M4: Skill development based on community request (community development plan), M5 : Water saving and improve water efficiency (water saving campaign, wet and dry irrigation method introduction), M6 : Increase water sources (rainmaking/well/pond), M7 : Secure health and security (health checking, nutriet and clean food provision, public security check), M8: Promotion of Community enterprise and inform weather information (emergency fund for suffered, social business enterprise soft loan, access to weather information via various means). Programs of both periods were summarized and compared in Table 3.

Table 3 Drought counter measures in 2014/15 and 2015/16

Year 2014/15	Year 2015/16
Preparation works	M1 Promotion of knowledge, cost down and change to other crops
Inform water situation	M2 Extension of rental fee and/or debt payment
Repair water gates	M3 Job creation or training
maintenance canals	M4 Skill development based on community request
review water allocations	M5 Water saving and improve water efficiency
Measures for farmers	M6 Increase water sources
find local water sources (ponds/wells)	M7 Secure health and security
recommend suitable crops	M8 Promotion of Community enterprise and inform weather information

From field questionnaires, the farmers in the central plain in the irrigation area were impacted from droughts in the year 2014-16 (40 samples, Sucharit K., Thongplew K., 2016). The impacts were from damages of agricultural product and worsen quality of product. Farmers in the rainfed area were impacted from water shortage and product damages. Farmers in the central plain in the irrigation area adapted themselves by reducing cultivation area, growing less water crop, using shallow groundwater wells and using loan to solve their problems. Farmers in the rainfed area changed to crops that use less water, reduce cultivation area as counter measures.

Irrigation engineers in the field informed that farmers in the central plain seek for other supplementary water such as shallow groundwater (88.9 %) and pond water (55.6%). Irrigation engineers introduced alternative wetting and drying farming method to farmers in order to save water, improve irrigation system to reduce water loss. They also had to create additional jobs for farmers who decided not to do farming such as weir construction(Sucharit K., Thongplew Kongjun, 2016). After the drought in 2014/2015, the study of salt intrusion management was conducted to set guideline for discharge control to prevent salt intrusion to water supply in the future (Sucharit K., et. al., 2017).

The evaluation of drought counter measures in the year 2015/16 was conducted from questionaires in the study area (Makasiri C., et al., 2018) and found that the overall results seemed to be satisfactory for farmers in the area as shown in Table 4. Most farmers received water data and were informed about amount of water to be allocated and

collaborated in water saving campaign. They registered with authorities to join the drought counter measure program and participated in some projects of the program. The farmers understood more the self sufficient economy way to adopt the living way during the drought period. Though, farmers showed the views to find more help on agricultural activites than for house hold supply provisions. Table 4 summaried the feed back from farmers surveyed (407 samples, Makasiri C. , 2018) in the study area.

Table 4 Evaluation of main measures from farmers

Item	Content
Input	• Regularly be informed about rainfall data • Regularly be informed about irrigation water allocated • Collaborated with RID to save water
Process	• Participated in the counter measure program • Regularly be informed about program activities • Registration process is fine
Output	• Farmers understand sufficient economy way • Needs assistances on agricultural activities than daily life consumption • Need to reduce agricultural production cost than reduce household cost

From field survey main reasons of farmers in irrigation areas with no adaptation to drought were due to not enough land (18.2%) and labors (18.5%), no knowledge about alternative/substitute crops (21.5%) and market (18.8%).

The drought counter measures of both periods, when considered from the WB's intergrated drought management approach (as shown in Table 1), can be assessed in each phase and items as summarized in Table 5. In the plase of monitoring, both periods conducted the plan with indicator (rainfall and dam storage) to support the decision making though in the year 2015/16, the measures were decided in October 2015 as prior preparation measures and showed active action than in the year 2014/15. In the phase of assessment, the progams for counter measures were actively identified though there was no improvement loop during or after the implementation. In the phase of mitigation, the pre-drough program was set in the year 2015/16 with response plan and safe/social net. In the phase of active response way, more comprehesive plan was prepared in the integrated manner among agencies with monitoring, knowledge transfer, salt intrusion study and weather data provison though no loss assessment was conducted.

Table 5 Assessment results of counter measures

Items	**2014/15**	**2015/16**
1. Monitoring		
1.1 plan	Yes (passive)	Yes (active)
1.2 indicator	Yes (passive)	Yes (active)
1.3decision support	Yes (passive)	Yes (active)
2. Assessment		
2.1 identified	Yes (passive)	Yes (active)
2.2 improve	No	No
3. Mitigation		M1-M8
3.1 pre drought	Yes (passive)	Yes (active)
3.2 response plan	Yes (passive)	Yes (active)
3.3 safety net	No	Yes
Items	**2014/2015**	**2015/16**
4. Proactive response		M1-M8
4.1 proactive	No	Yes
4.2 loss analysis	No	No
4.3 improvement	No	Partial
4.4 capacity building	No	Partial

Remarks:based on field survey in 2015, 2016, 2017(Sucharit K. and Thongplew K., 2016, Sucharit K., et. al., 2017, Makasiri C., et. al., 2018)

5) Bang Rakam model as an integrated case

To understand the drought counter measure in the local scale and more integrated way, Bang Rakam retention project was selected as case study area (Figure 1), with low land area group as shown in Figure 5, to see the effectiveness of drought counter measures as a co-benefit scheme for both flood and drought mitigation solution. This approach had been proposed and indicated in the short term measures after Floods 2011 (Sucharit K., 2013). The Bang Rakam retention area with the area of 61,120 hectares suffered from flood and drought from the past periodically recurring due to the low land area and with no upstream reservoir support (as scene in Figure 6).

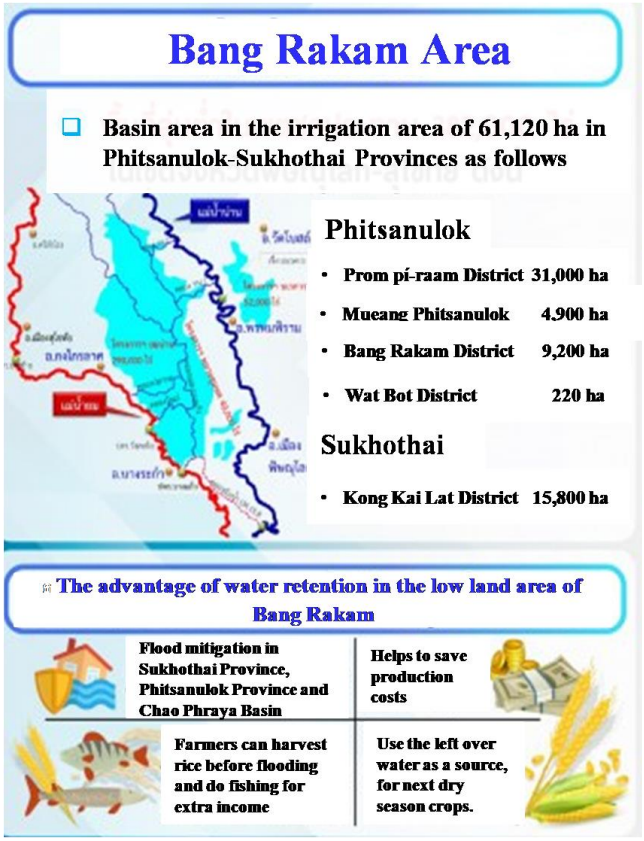


Figure 5 Bang Rakam Retention location and advantages from being water retention

Figure 6 Recurring flood scene

Up to now, there were requests from the farmers to have flood protection dyke and house heighten scheme to save from floods (Kitcha Promma, 2014). With the aims to mitigate both flood and drought, reduce flood loss with extra incomes from fishing, in 2017, RID took counter measures by improving dykes and set pumping stations at downstream to control water more efficiently as a hard measure in the area of 265,000 rai (42400 hectares) called as Bang Rakam Model. In the same time, the soft sided measures were initiated by shifting cultivation schedule (as shown in Figure 7). The rainy paddy planting period was shift from May to April so that all plants could be cultivated within August before floods came. During September-November, the area were prepared for flood retention and farmers shifted to do fishing instead. The summer paddy started again in December and cultivate in March next year using the left over water, i.e., the retention water was controlled at 30 cm depth at the end of November. (RID, 2017)

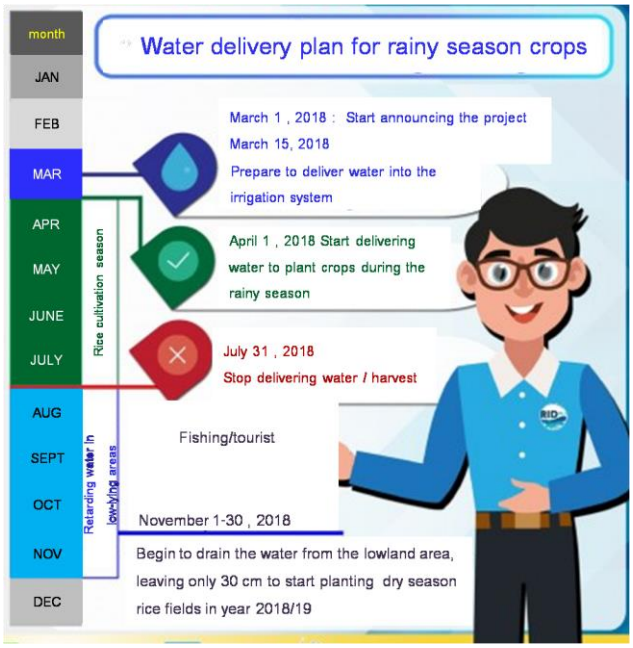


Figure 7 Plantation schedule shift

The assessment work was conducted to follow up the implementations in the year 2018 and found that the Bang Rakam project area were extended to cover 382,000 rai (61120 hectares) and farmers could cultivate on time with the planned schedule and earned stable incomes from two paddy cultivations (rainy and dry seasons) plus fishing and tourist activities. Farmers were satisfied with the retention scheme and requested the authorities to dredge canals more for water storage and to need more information on new paddy species to fit with new cultivation environments (AOE, 2019)

From the success of Bang Rakam model, RID plans to extend the similar scheme to the lower Chao Phraya Basin (another 12 retention area with the area of 1.15 M rai (24000 hectares which can store water about 1533 M cum)) in the near future which can be used for retention area for flood peak reduction in the rainy season and water storage for dry season in the same time (RID, 2017).

There were few studies commented on the approach that more active public participation in these retention scheme should be carefully considered in the implementation preparation process to get mutual agreement of farmers and agencies to make the project more effective and efficient (Thanaporn Trakuldit, Nicolas Faysse, 2019; Sjoerd Voogd, 2019).

From the case study, the flood-drought counter measures had been planned and executed in 2017 with more systematic and integrated ways (in the phases of monitoring, assessment, mitigation and proactive response based on WB approach) and the scheme was assessed in the year 2018 with satisfied results. Though, more active public participation and discussion should be aware for better effective and efficient execution in the next year.

6. Conclusions

After 2011 floods, Thailand faced with consecutive drought periods as shown from rainfall and dam storage data. Farmers had been affected from the drought situations and from the field survey, farmers had to find various adaptations to counter with the situation while government had implemented various schemes of drought counter measures and improved by time.

The drought counter measure program in the year of 2015/16 was assessed based on the WB approach and found that the program was more comprehensive and more proactive for drought management. This was confirmed with the field survey from farmers in the study area.

In 2017, the drought counter measure program was improved in the integrated way of response in the low land area like Bang Rakam Project by including climate change adaptation approach of both drought and flood mitigations via cultivation shift, mixed agricultural activities with paddy and fish cultivation in the retention area, though more active public participation should be considered in the future project preparation stage.

7. Recommendations

The drought counter measure program can be further improved for future via improvement loop with drought characterization and loss assessment results after the event and capacity building in community level via information, knowledge dissemination (on alternative crop and market), early warning provision and more active public participation.

8. Acknowledgements

The authors would like to express sincere thanks to RID' staff for the assistance of interviews and farmer questionnaires in the study area. We would like to thank RID, TMD, for data provision to conduct this study. The study was conducted at the Water Management System Research Unit, Chulalongkorn University, Bangkok, Thailand and funded by Thailand Research Fund (TRF, now change to TSRI) and NRCT.

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