CTCN City Climate Vulnerability Assessment and Identification of Ecosystem-based Adaptation Interventions, Lao PDR, January 9th to 19th

Contents

1 Introduction

In the spring of 2016 Lao PDR requested CTCN to initiate a Rapid Response plan that could pave the way for an application for the Green Climate Fund, GCF. The focus for the GCF was to assess the possibilities to identify ecosystem-based services in the urban and peri-urban areas that could help in reducing or mitigating floods in these areas. In addition, the GCF is interested in whether ecosystem-based flood control measures can yield co-benefits by contributing to other ecosystem services (for example, using flood flows for irrigation, or natural flood storage for farming or recreation). The assessment should also look into whether the existing ecosystem services would be available under changed climate conditions. This work was initiated in August 2016, where DHI on behalf of CTCN visited Laos and facilitated 3 workshops with involvement from the 6 designated cities to get a better understanding of the present conditions under flooding and where ecosystem services could be of help in the future. A part of the visit in August was also to establish liason with the National Designated Entity, NDE, which is under the Ministry of Natural Resources and Environment, Department of Disaster Management and Climate Change. Relevant ministries and departments both under national and provincial level were visited. The outcome is referred in the Mission Report from August 2016.

The outcome of the mission in August 2016 has provided the basis for the Response Plan, which will be carried out between January and June 2017, and the plan was initiated with an interim consultation and workshop during 9th-19th January 2017.

2 Overall travel and visiting Agenda

The team from DHI visited Laos PDR between 9-19 January and it was lead by Mr. Henrik Garsdal, HEG (8-16 January) and with participation from Mr. Jesper Goodley Dannisøe, JDA and Mr. Niels D. Riegels, NDR (16-19 January). The schedule for the trip is presented in Annex 1.

2.1 Meetings with ministries and departments

January 9th

Meetings with Ministry of Natural Resources and Environment, Department of Disaster management and Climate Change (DDMCC), responsible department for the NDE. Met with the NDE in the afternoon. Mr. Syamphone Sengchandala, director for the DDMCC and his team. Focus was to ensure alignment of working programme and schedule for the two weeks. The DDMCC had appointed four teams as part of the NDE:

- External coordination (responsible Mr. Amphayvanh Oudomdeth)
- Stakeholder/province offices coordination (responsible Vannavong Manivong)
- Technical content team (responsible Chanty Intravong)
- Admin team (responsible Ms. Phonesouk)

Additional staff allocated for the project:

- Mr. Ped Saiyasit , Team assistant
- Mr Vilakhone Maniphousay; Key responsible for data collection and communication with provincial contact persons.
- Mr Chanchavone Keamanouvong, Team assistant
- Ms Aliyavonn Laworgtheung, Team Admin

The DHI team has included Mr. Phaivanh Phiapalath as local consultant.

January 10th

Stakeholder meetings on data with:

See list made by NDE. All meetings were held except with Dept. of Water Resources.

Meeting with Ministry of Public Works, Department of Housing and Urban Planning. Mr. Khamphavy Phaiphachanh.

The same department was met in August and during a short briefing it was stated that the department is in position of masterplans from all 6 cities in various formats. (digital, hardcopy)

Mr. Viragith Douangchanh is still the contact person (st037053@yahoo.com).

Meeting with Department of Water Utility. Mr. Noupheuak Virabouth.

The department is responsible for water supply and waste water plans and also larger investments in the sector. The contact person is Mr. Virabouth. DHI will send Mr. Phaivanh to select and pickup data. Reference given to an ADB study: 'Regional Climate Change Study'.

Meeting with Department of Land Planning. Mr. Touy Thubmavong.

Topodata, and satellite and remote sensing data to be obtained by National Geography Institute. Suggested that we obtain Flood maps at Ministry of Water Resource.

The National Master Plan of Land is available for the CTCN study. The Master Plan can be obtained in softcopy by issuing a request letter from the DDMCC. Also detailed provincial reports can be obtained.

Meeting with Department of Forest Resource Management. Mr. Saysamone Phothisat.

Forest areas in the peri-urban (in the city level) areas belong generally to the PONRE's. The Department of Forestry has forest cover maps from the years 2000, 2005 and 2015. An official letter from DDMCC needs to be issued to obtain the data.

Meeting with Public Works Institute. Mr. Xayabandith Insisiengmay, The Environmental and Social Division.

Copy of the three data pages from the August mission report were provided to PWI. Accordingly PWI will check whether they can support with data of the various categories. Phaivanh to follow up by checking the outcome. Hereafter DDMCC can send a request letter.

Meeting with Department of Water Resource.

Met with Mr. Phousavanh Fongkhamdeng, Deputy Director and his assistant.

The department is responsible for the water resource planning. The department is looking after 62 river basins, of which 10 are important river basins. There is a close corporation between the department and the provincial offices. The department have produced River Basin Management Plans (some in English, some in Lao language) for the major basins, including the ones embracing the six cities that is the scope of the CTCN study. Some of the River Basin Management Plans include Flood Management Plans. The River Basin Management Plans can be shared with the CTCN study. According to the Deputy Director, there is no need for a request letter, presumably because the NDE and the Water Resource Department belong to the same ministry. Exchange will happen between the Deputy Director and Mr. Ped Saiyasit from DDMCC.

Besides the management plans, the report 'National Water Resource Profile 2008-2009' is worthwhile to get hold off.

Actions from the meetings

Phaivanh to take contact with Mr.Viragith at Dept. of Housing and Planning (go through the Masterplans, ensure access to the important parts of the Masterplans, get copies hereof, preferably in digital format)

NDE to send request letter to Dept. of Land Planning (National Land use plans, plus provincial reports of the same)

Henrik Garsdal to make sure that NDE takes contact to National Geographic Institute (topo data) and to Forest Dept. (forest cover maps)

Henrikl Garsdal to make list of rainfall and WL stations and send to Phaivanh who shall take contact to Hydro-Met for data retrieval.

3 Visits to the six designated cities

Each of the six workshops/consultations at city/provincial level all had the same agenda with opening address made by the local counterpart, mostly from the local Ponre's, and a short address delivered by the NDE. The DHI team thereafter presented the overall principles in the project, inclusive of highlights from the August 2016 consultations and also an extended presentation of the principles in working with ecosystem services. The presentation was altered dynamically along the way to include more examples and also a listing of data needs. After the presentation from DHI, the local authorities presented their suggested sites for further work. DHI had provided each of the cities with a descriptive form and an example of how to choose a site and how to describe the flooding situation, inclusive of listings of damages to ecosystem services, infrastructure systems and other information. The form is presented in Annex 2.

Overall, the majority of flooding events in the cities along Mekong River coincide when the water level in the main river and the tributaries are high, due to heavy rains in both the local catchments and in the whole Mekong catchment as well. High water levels in the Mekong can also result from upstream dam operations. Most of the cities are fairly well protected by dikes and high embankments along the Mekong and to a certain extent also along the major tributaries, but in several places the water backed up in the tributaries will spill over and cause floodings in the city, with water coming from the hinterland.

On the other hand, local flooding from high-intensity rainfall events in cities does not yet appear to be a significant problem in most of the cities. This is perhaps because permeable surfaces are still widespread in the designated cities, particularly in peri-urban areas. Therefore, the CTCN response may provide an opportunity to provide guidelines for maintaining so-called "green areas" and using permeable surfaces as urbanization continues.

The results from discussions in the cities are given below as notes.

3.1 Visit to Vientiane Capital, January 11th.

Presentation.

Discussion on project sites. Different types of flooding:

Natural flooding along the Mekong River.

Heavy rain in the city areas.

Flooding in the city, twice (1966 and 1995), backwater from Mekong means that the city could not drain its water and flooding occurred. Flooding in the city is from heavy rain, duration is about 6 hours. A water gate is implemented, but they still need to evaluate/see how it works. Release of water from a dam creates flooding downstream.

VTE, Site 1: Beung That Luang. Urban city site (not peri-urban area). The authorities need to work across different sectors (transportation, drainage, env., etc.) to solve the flooding problems in this area. A newly built office building for one of the ministries will

discharge all the surface water to the local small channel. At present the roof water is drained to the stream and it has already caused problems with flooding on both sides of the highway and has caused local problems for land-owners. The area around the new building has not yet been surfaced, but if the standard method with complete concrete-sealed surfaces will be used, it is expected that the flooding problems will increase and may also give a direct impact on the new ministerial building. It was suggested to work with natural depressions to store roof water and use permeable cover on the areas around the building.

VTE, Site 2: Ban Saythani. It is a smaller village (we can consider this as a peri-urban area) being flooded occasionally and sometimes exercabated by the release of water from Nam Ngum reservoir (hence not natural flooding). There are 11 smaller rivers in the village. A part of the village is recently being developed and flooding due to rainfall occurs. Previously there was flooding of the paddy fields in this area, now the flooding takes place in the newly developed city areas. There is quite some difference between planned development and 'as built'. Right now there is no approved city plan for the area, but development is still taking place.

Vientiane capital have filled the Survey Questionnaire, but are willing to update the write up after the workshop and field visit to the site.

[Maps are missing. Positions needed from NDE]

3.2 Visit to Luang Prabang City, January 12th and 13th

Meeting with PONRE and other relevant regional authorities, Luang Prabang.

Mr. Amphaivang gave a speech, followed by the chairman of Ponre. The CTCN presentation was given, followed by a presentation of four selected sites in the city and in the rural/peri-urban area. There were considerations regarding un-registered and un-warned releases from three upstream hydropower dams, of which only one is currently producing electricity. The dams release to the local river, entering Mekong just north of the old city and if the release of water co-insides with high levels in Mekong, the water in the river cannot enter the Mekong and backwater may cause floodings in the city area.

After presentation and discussions the sites were visited.

LPB Site 1: Houay Mao Bridge: The stream passing the bridge over the main road towards the airport was flooded in 2015 due to severe rain in the catchment and to high level of water in both Mekong and the local river, Nam Khan. It was estimated at the site that the water level in the river under the bridge must have been 6-8 meters above present level and this must have caused severe flooding both of the road and the houses close to the stream. LPB Ponre will check whether the event was unusual, making use of rainfall data. However, it was also discussed that events like the one at the bridge can only be reduced if the whole catchment is analysed for changes like de-forestation or other substantial

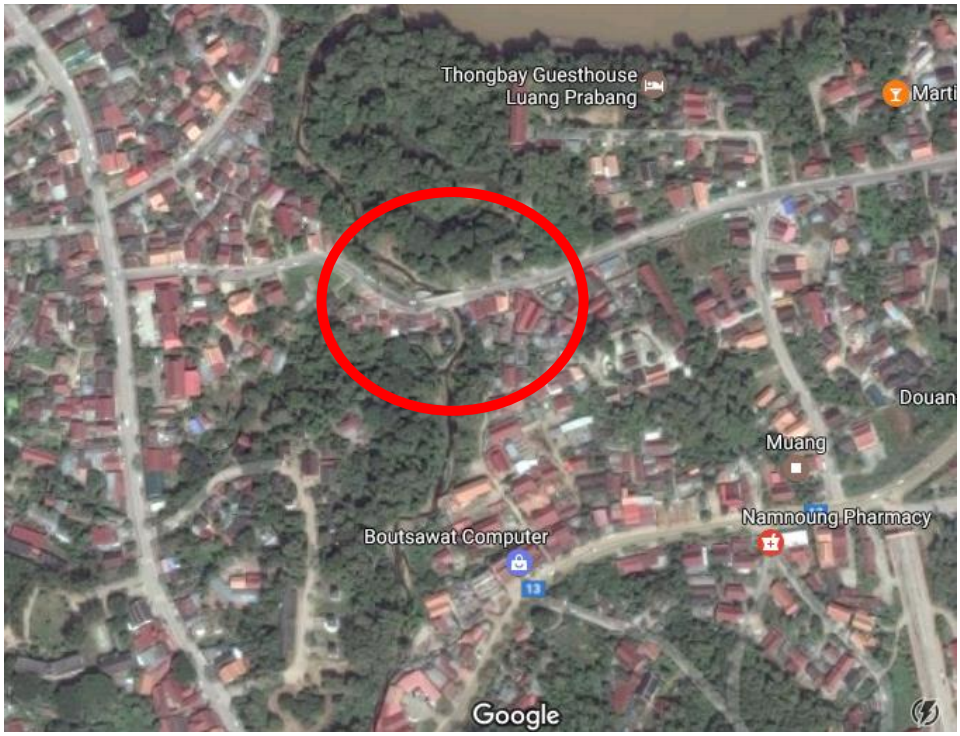


Figure 3-1 Luang Prabang, Site 1.

land-use changes, which has led to a situation, where the rainwater cannot be retained as long as previously in the catchment.

LPB Site 2: Ban Hog New Village, approx. 8 km from LPB: The small village is situated along a stream, which 3-4 times per year floods parts of the village. The floodings are short, but intense and usually bring large amounts of soil and mud, which fills up the street and the houses adjacent to the stream. The key damages are to property along the river, whereas houses away from the stream are not damaged. There are also damages to cropland up- and downstream of the village. The stream passes a quarry upstream and a visit to the quarry showed that there is no protective walls or dikes to prevent soil and mud from the quarry to run into the river. The two culverts seen in the village were both more or less blocked with debris and sediments and were by far too small to take the flow from the stream. Therefore, the culverts are expected to act as places where the water is forced into the street, causing the problems.

The damages, besides the physical load of soil and mud were mainly on cropland, and on the water supply system in the village.

The main operational possibilities lies with having a better control with the landuse upstream and potentially assess whether riparian land upstream of the village could be used for intentional flooding, thereby using the ecosystem service provided by the riparian zone for slowing down the speed of the water and thereby take out some of the sediments before reaching the village. In addition, the run-off conditions in the quarry must be assessed to ensure that the village does not suffer from un-intended soil and mud transport from the quarry. Protective dikes and ponds may be used to reduce the soil transportation into the stream.

Figure 3-2 Luang Prabang Site 2.

LPB Site 3: Flooding of the main road near the Southern Bus terminal. The main road is sometimes flooded due to rainwater systems, which are not fully maintained and by housing, which have encroached the natural perimeter of the stream. This leads to periodical flooding across the main road. An inspection in the area east of the main road showed that there are small open areas and wetlands that could potentially be used for temporary storage of water during heavy rain, but the site was not considered further.

LPB Site 4: Bank erosion along Nam Khan. A recent slide of the left bank on the eastern side of the peninsular has damaged the road and curbside and unless hard-core engineering efforts are used, the brink might eventually fall into the river. Inspection of the site showed that various un-authorised terraces and other structures incl. of wastewater- and rainwater drains have been located on the brink. It was concluded that the site would not fit into the criteria for the CTCN- project and the Green Climate Fund project either, as the bank collapse encountered has to do with constructions, brink constructions and probably also irregular release of water from the upstream dams, which may have weakened the side of the river, causing instability and accordingly a slide of the brink.

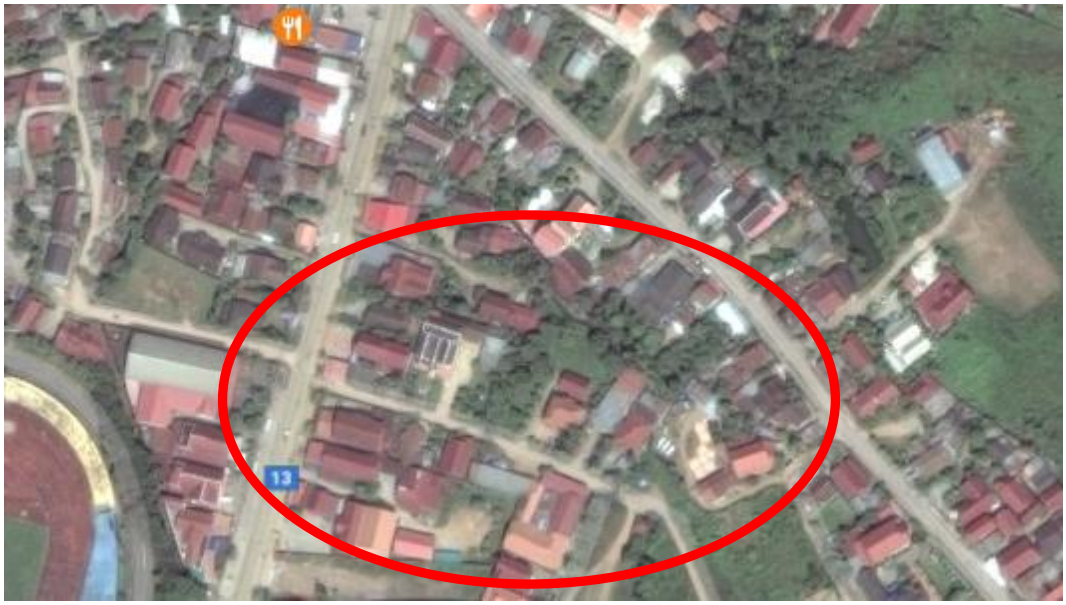


Figure 3-3 Luang Prabang Site 3.

Figure 3-4 Luang Prabang Site 4.

3.3 Visit to Pakxe City, January 16th

Meeting with PONRE and other relevant regional authorities, Pakxe. The team presented their speech and the word was given to Pakxe authorities to present their sites. It was obvious that almost all of the sites discussed were heavily impacted by backwater from Mekong and that a substantial part of the impact from backwater was caused by non-functional water lock systems. The overall conclusion was that if the locks were to work properly, it would be possible to work with ecosystem services in some of the chosen sites, but not all.

PXE Site 1: Ban He, Hoy Ya stream: The water lock established by the road has not been finalised and it cannot stop backwater from Sedone river and Mekong. However, if the lock was finished it could potentially reduce the impacts on the backland and it would then be possible to work with local ecosystem services in the area, as several areas are left open and could be used for additional storage and seepage for rainwater. These areas could also be used for cultivation when flooding is not taking place. However, it will not be possible before the water lock is finalised. The flooding takes place once a year and lasts for 2-5 weeks, depending on the water level and duration in the Mekong River. It is not known if upstream conditions (i.e., deforestation) in the Sedone catchment have contributed to increased flood risk in recent years.

Figure 3-5 Pakxe, Site 1.

PXE Site 2: Confluence of River xx with Sedone. The confluence site as visited as a suggested site. The problem is the same as for the downstream site: Backwater from Mekong, combined with potential influence from release from upstream reservoirs will impact the flooding in the backland. The only solution at the site would be a water lock, which could keep the backwater out of the area. However, the site was not considered relevant as a site for the present project, neither for the Green Climate Fund project.

Pakxe; Site 3 and 4; Pumping stations and drainage channels. The two sites are close to each other and are built at the end of two drainage channels, feeding sewage and drainage water to the outlet. Both outlets are equipped with sluice gates, but these are not finalised and completed. The same happens for both areas; When the Mekong reaches approx. 8 meters, water will be forced into the backland and will cause flooding for all land below the water level in the Mekong. Working with ecosystem services does not seem feasible before the gates are functioning and can protect the backland. The structure to the right in the figure illustrates the drainage channel and the wastewater treatment plant. The plant is based on a string of oxidation ponds.

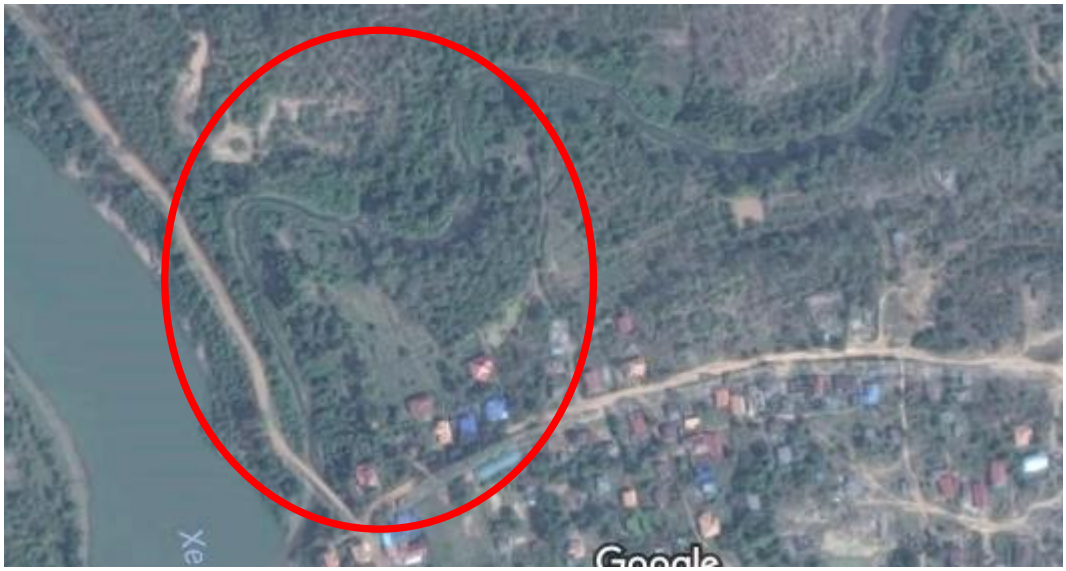


Figure 3-6 Pakxe, Site 2

Figure 3-7 Pakxe, Site 3 and 4.

PKX: Site 5: Drainage channel in Ban Kae. The village of Ban Kae lies across from the Sedone River, close to the airport. The main drainage system is similar to the two previous sites, but if the sluice gate can be fixed, it is expected that the area behind the gate can be optimised to cope with local rain-made floodings by working with ecosystem services. There are many green areas in the village and a proper management of these may offer the necessary green elements that can be used to retain and handle rainwater locally and thus reduce impacts from flooding in the areas behind the gate. It was recommended to use this site as one of the sites for Pakxe and start working with stakeholders to identify ecosystems services to be used, both for flood control and to derive co-benefits from natural features used for flood protection. As the area also gets water from upstream villages, it was also suggested to assess how water could be retained in those areas as well.

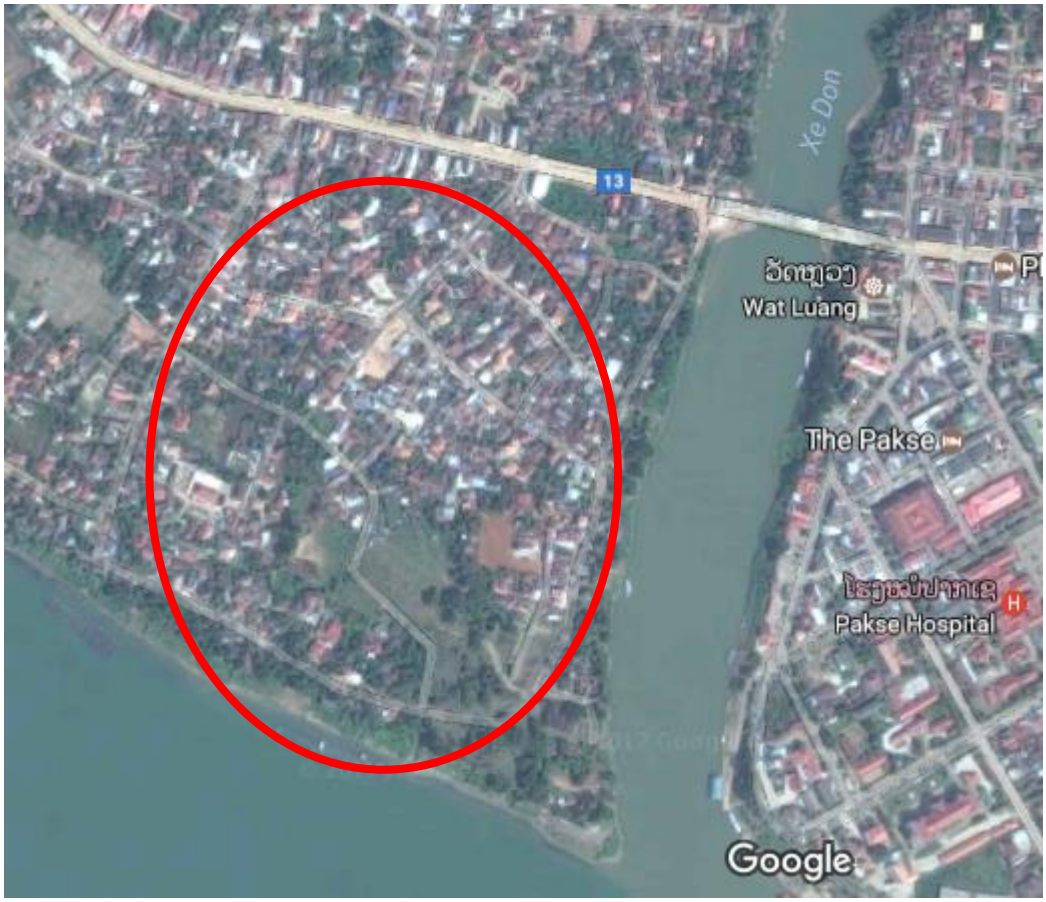


Figure 3-8 Pakxe, Site 5.

3.4 Visit to Kaysone Phomvihane/Savannakhet, January 7th

The city was visited on 17 January and the delegation was received in Ponre. The presentation about the project was delivered and afterwards the potential sites were discussed. The city have had several sites up for discussion and many of those were considered being too far outside the city to qualify for being peri-urban in context.

SVK: Site 1: Hoang Loun Kong. A large part of the central city drains to the HLK, which starts in a densely populated area. On its way towards Mekong it is met with several tributaries, all transporting sewage in the dry season. The HLK passes large agricultural areas close to the airport and during flooding, the paddy areas are flooded, as are parts of the dwellings along the river. As with so many of the other cities the main cause for flooding is high water level in Mekong, which forces water into the river and prevents a proper draining of the area. The site was found appropriate, as it would include both densely populated areas and open areas, useful during flooding. There are no immediate plans for establishing water locks close to the river, but it may be considered to install locks further up in the system. The site will provide possibilities for using open areas in the city to provide flood protection and other benefits.

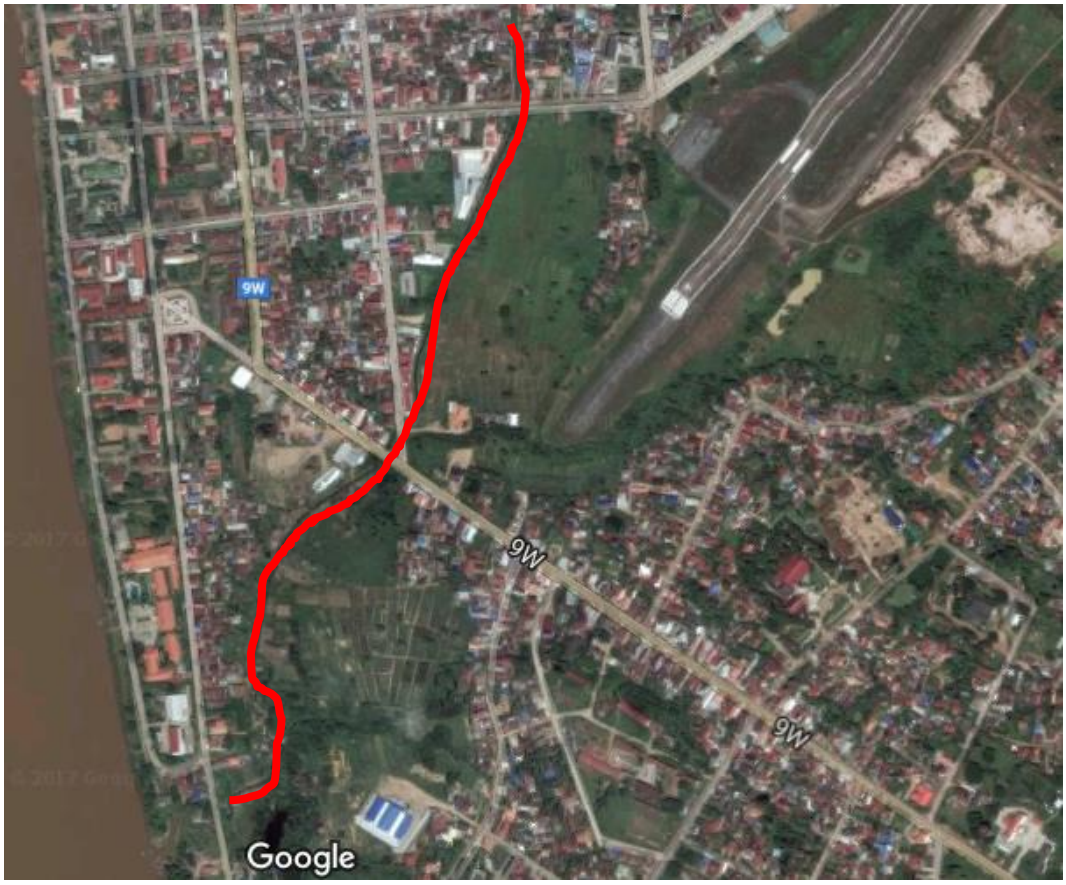


Figure 3-9 Kaysome Phomvihane, Site 1.

3.5 Visit to Thakhet, January 18th

The city of Thakhet was visited on 18 January and the meeting started with presentations in the Ponre. The various sites were presented by the participants, but none of the sites were finally decided upon. In general, like many of the other cities along the Mekong, the typical flooding events take place, when the water level in the river is high and forces water into the tributaries.

TKH Site 1 and 2: Future development area along Highway 12 towards Vietnam. The site is on both sides of the main road, but not close to the city and the plan looks at developing the area within 10-20 years. Flooding comes as flash floods from the nearby mountains, but are also influenced by water backing up into the local river, Nam Don. The sites cannot yet be considered urban or peri-urban and therefore it was decided that neither is appropriate for the assistance.

THK Site 3, 4 and 5. Catchment in the peri-urban area of the city, near Ban Non Bo. The upper part of the catchment is in the city and spreads out into a flood plain, used for grazing, paddy fields and fish ponds. A road crossing the flood plain acts as a barrier between the upper catchment and the lower catchment, where the lower is impacted by backwater from the Mekong. There are no water lock systems at the confluence with Mekong. The upper catchment is mainly impacted in terms of floodings caused by rainfall in the catchment and it is mainly agricultural land, which suffer from the flooding, whereas both land and houses are flooded in the lower catchment. The visit included visits to 3

sites, going from the road crossing the flood plain, seeing one site at Paximay Houang and finally the confluence with Mekong.

The upper catchment site is considered interesting because it provides opportunities to use ecosystem services in the urban part of the catchment for flood control and to provide other benefits. During the lunch the site was discussed and it was agreed that the authorities would work with the site and deliver data and information to the NDE.

Figure 3-10 Thakhet, Sites 1 and 2

Figure 3-11 Thakhet Sites 3, 4 and 5

3.6 Visit to Paksan, January 19th

The city of Paksan was visited as the last of the six cities. The delegation was welcomed by the local Ponre. After the presentation the proposed site was presented. It is a very large catchment, which is tied to the river Nam Zan. The flooding events were discussed before the sites were visited. The city has decided to concentrate on this one site, due to its complexity.

PKS, Site 1: Ang Houy Peung and along Nam Zan. The river is relatively large and is as all the other tributaries highly influenced by the water level in Mekong. A road leading up along the river has been improved to withstand water levels in Mekong of 15 meter, the highest recorded in resent time. Settlements on the river side of the road are flooded annually, and settlements on the other side are also sometimes flooded, but by water entering the catchment further up and coming down along the road. Despite the laws covering the building code, most houses have been built without taking the necessary precautions to avoid direct flooding in the houses. Most houses are not on polders or of the stilt-type and are accordingly flooded annually for 2-5 weeks.

PKS Site 2: Ban Tabor, upstream of Ang Houy Peung. The village next to the Nam Zan is situated on a small elevation and was only flooded severely in 2014. Speaking to the village people did not tell when the previous severe flooding took place. There were pictures of the flooding of the village in 2014, indicating a water level of 30 cm at the temple site.

The cropland around the village and the access road are flooded annually for 2-5 weeks, cutting the village off from e.g. access to the markets and the health care. The representative from Dept meteorology was asked to find data on precipitation to create an overview of the recorded flooding in 2014 was caused by extreme rain or was within the normal range.

The conclusion after seeing the sites was that the city, villages and catchment must be seen as one unit and that changes in the catchment must be analysed to see if there are links. It was suggested to investigate how far the direct impact from backwater from the Mekong reaches in Nam Zan and focus on using local landscape features for flood control upstream of this border.

Figure 3-12 Paksan, Site 1

3.7 Summary of sites relevant for CTCN

In summary, several of the sites chosen by the cities did not directly qualify as potential project sites, mainly because some were in rural areas and some were sites, where the problems were caused by lack of maintenance and where ecosystem services would not be capable of solving flooding incidents. Table 3-1 provides an overview of the sites.

Table 3-1 Overview if the sits selected by the cities. The table also shows the evaluation from the expert team, whether the sites would qualify for further work under CTCN/GCF.

			Influenced by:		Suitable?	
City	**No**	**Name**	**Mekong water level**	**Local rain**	**CTCN/GCF**	**Remarks**
VTE	1	**Beung That Luang**		X	Yes	Direct work with ecosystem services on publicly owned land around new office building
	2	**Ban Saythani**	X	X	(No)	Flooding problems caused both by MK river and reservoir releases
LPB	1	**Houay Mao Bridge**	X	X	Yes	Catchment management
	2	**Ban Hog New Village**		X	Yes	Catchment management
	3	**Flooding of the main road near the Southern Bus terminal**		X	No	Drainage structure problem
	4	**Bank erosion along Nam Khan**			No	Dam operation and brink management
PXE	1	**Ban He, Hoy Ya stream**	X	X	No	Needs physical structures in place prior to GCF work
	2	**Confluence of River xx with Sedone**	X	X	No	Requires large water lock
	3,4	**Pumping stations and drainage channels**	X	X	No	Infrastructure problem
	5	**Drainage channel in Ban Kae.**	X	X	Yes	Minor physical changes can lead to a good project site
SVK	1	**Hoang Loun Kong**	X	X	Yes	Urban and Peri-urban in one site
THK	1,2	**Future development area along Highway 12 towards Vietnam**	X	(X)	No	Rural area, will be developed in 10-30 years
	3,4,5	**Catchment in the peri-urban area of the city, near Ban Non Bo**	X	X	Yes	A large site with urban and peri-urban elements
PKS	1,2	**Ang Houy Peung and along Nam Zan, Ban Tabor, upstream of Ang Houy Peung**	X	X	Yes	A large site with urban and peri-urban elements

4 Key observations

The assessment of the many sites showed that on 10 sites out of 14 visited, high water level in the Mekong River contributes to flooding. The flooding is mainly caused by water from Mekong being forced up into smaller tributaries at the same time that significant runoff events take place on the tributataries themselves. These phenomena are observed both in urban or peri-urban areas and on agricultural land. The urban areas of cities along the Mekong are in general well protected by dikes and embankments. However, some area (for example, Paksan) are affected by flooding originating from tributaries in backcountry areas, which occurs even though the the core of the city is protected by dikes along the Mekong River.

The magnitude, frequency, and extent of the flooding varied among the sites. However, feedback from the site visits suggests that it is common for flooding to occur annually with a duration of 1-5 weeks. Some sites are protected from flooding from the Mekong by water lock systems; however, in many cases, these facilities are either unfinished or are not functioning.

Four sites were identified where flooding was caused by local events, of which only two were considered suitable for CTCN assistance. In both cases, land-use changes in the upstream catchment may be contributing to increased flooding.

4.1 Ecosystem services

Field visits and discussions with local authorities suggest that ecosystem services are already in wide use, even if the ecosystem services concept is not well understood. The most used service is the capability of the land to contain the water during a flood event, which is often categorized as a “Regulation and maintenance” service in efforts to standardize and define ecosystem services (i.e., the Millenium Ecosystem Assessment, Common International Classification of Ecosystem Services). However, the use of landscape features to control flooding is often looked upon as a waste of land and not as a service that reduces flooding to other areas where houses and roads are placed.

Flooding of agricultural land is considered a nuisance, which disregards other ecosystem services associated with flooding, including replenishment of soil and nutrients, as well as groundwater recharge.

The following ecosystem services are associated with the use of natural landscape features for flood control:

- Replenishment of topsoil (through deposition of suspended material)
- Replenishment of nutrients and organic matter in soil
- Groundwater recharge
- Pest control
-

Maintaining nursery populations of fish in pond areas Because some of the services described above are not well-understood, local authorities have in some cases underutilized the possibilities provided by the controlled use of natural landscape features for flood control.

Although this assistance will focus on the use of natural features for flood protection and associated ecosystem services (as listed above), the assistance will also provide guidelines on the use of so-called green spaces in urban areas (e.g. parks, gardens etc) for flood protection. Although flooding from urban storm runoff is not yet a problem in most cities in Laos, this is most likely because urbanization has not yet proceeded to the extent where green spaces have been excluded from the urban landscape. In order to ensure good practice as the urbanization of Laos continues, this assistance will provide guidelines on flood control services and other services provided by green areas, including:

- Providing permeable ground for seepage of rainwater
- Providing storage of rainwater (and flood water)
- Reducing heat-islands in the urban landscape
- Increasing recreational and leisure opportunities

Although local authorities and stakeholders are well aware of damages to livelihoods and property caused by flooding, uncontrolled flooding can also damage other ecosystem services that may make important contributions to human welfare. These include:

- Damage to crops in fields
- Reducing easy access (on land (roads), streams, river)
- Temporary damage to forests and other places, where provisioning services are harvested.
- Damage to un-protected aquaculture facilities
- Damage to land with housing
- Damage to water supply (sediments and suspended solids enter wells and supply systems and reduces water quality and create damages to equipment).

Due to the fact that many of the services described above are not recognised as services the authorities have not worked directly to utilise and expand the possibilities provided to them from nature. The damaging effects from flooding has been the main concern and therefore seeing the flooding in a positive perspective has not materialised.

4.2 Utilisation of ecosystem services

This analysis seeks to increase public recognition of the benefits of using natural landscape features and green areas for flood control, along with other ecosystem services associated with controlled flooding. Local authorities and stakeholders should recognize that flooding of designated areas, including urban green spaces and agricultural lands, is a useful and cost-effective way to reduce flooding impacts on roads, houses and other important infrastructure elements. An operating principle for this assistance could be, “rather flood the fields than the infrastructure”. This assistance proposes to move forward by mapping of flood-prone areas and then identifying possibilities for using natural landscape features for flood control.

In addition, it is important to estimate the extent to which the Mekong River and runoff from local catchments contribute to flooding. The flooding caused by water from the Mekong may take place in the absence of significant local runoff, but could also coincide with local extreme events.

The site visits suggested that land use changes in upstream catchment areas may contribute to flood risk by reducing absorption capacity and thereby increasing the intensity of runoff to rivers and streams. It is therefore advisable to assess conditions in upland catchment areas before local initiatives to utilise e.g more agricultural land for flooding are taken.

The interviews carried out during the site visits indicated that flooding typically takes place in June-August with a typical duration of 1-5 weeks, although substantial year-to-year variations exist. Flooding is regarded as a nuisance when it hits infrastructure like roads and houses, and to a lesser extent when it impacts agricultural land. The reason that flooding of agricultural lands is not perceived as negatively as the flooding of roads is houses is likely because this type of flooding impacts fewer people, even though damages to crops could result in significant economic damages.

This assistance will seek to create better understanding of other ecosystem service benefits accompanying controlled flooding. Because flooding can both benefit and damage agricultural lands, a flood control approach that utilizes farmland for attenuation of flooding could be difficult to operationalize because of uncertainty about the timing and magnitude of flood flows. However, analysis of flood frequencies and other hydrological data from the Mekong River may help to reduce uncertainty and risk for farmers participating ESS-based flood control schemes.

Increased utilization of natural landscape features for flood control must be accompanied by assessment of hydraulic and hydrologic potential of different areas to attenuate flood flows, either through temporary storage of surface runoff, or by routing surface flows to groundwater through seepage. Such assessments could help optimize the use of natural landscape features for flood control, reducing the cost of associated infrastructure such as dikes, channels and other features. It may also be possible to combine investments to improve utilitization of agricultural lands for flood control with investments to improve irrigation. A representative scheme was observed in Paksan, where an area that is irrigated using flood irrigation during the wet season is also irrigated with the help of pumping during the dry season, enabling local farmers to produce two rice crops per year.

4.3 Combined grey- and green infrastructure

At a number of sites in the cities visited, it was observed that presently green areas in the cities interact with structural facilities. In some cases the outlet from a green area was control by a steel metal flap gate set in concrete. However, due to lack of maintenance (and perhaps initial construction), the outlet does not function according to the intention and specifications, and hence the full utilisation of the green area as an ecosystem service is prevented. In case the outlet was repaired, the green area could work in a more optimal fashion, and to a larger degree serve as a flood preventing facility.

The enabling of such kind of system interaction could well be considered both for the CTCN assistance and the GCF proposal, as long as the proposed investment is minor.

Annex 1 Mission schedule

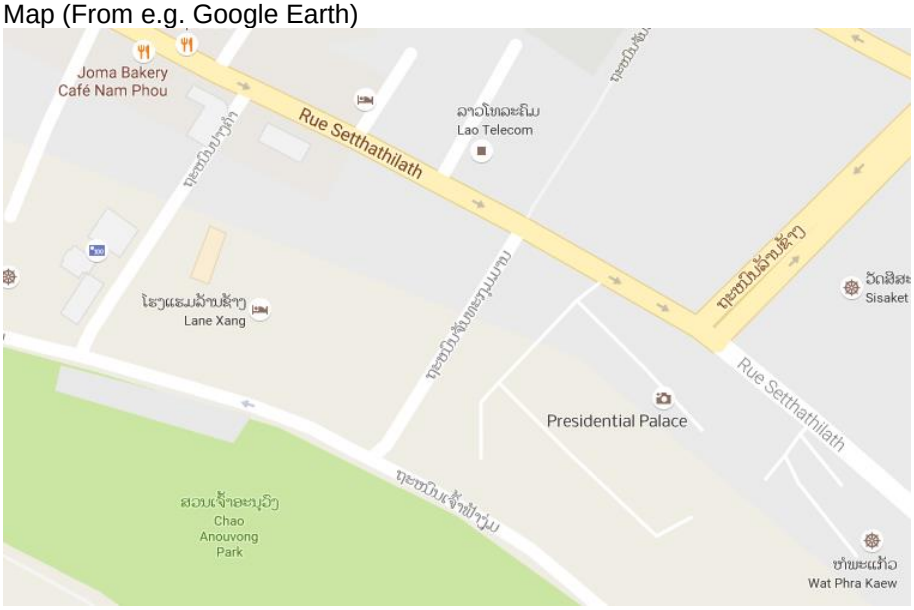
Day	Date	Activity	Agencies involved
Sun	08-jan	DK staff leaving Denmark	
Mon	09-jan	Arrival of DK staff. Afternoon visit to NDE for planning.	NDE
Tue	10-jan	Visits to stakeholders for acquisition of data. Ministry of Public Works and Transport - Public Works Institute. Department of Housing and Urban Planning. Vientiane City counsil. Department of Water Supply. Department of Land Planning and Development. Department of Water Resource. Department of Forest Resource Management.	Representatives from the stakeholders mentioned
Wed	11-jan	Meeting with Vientiane City authorities. Field observations for two flooding events in Vientiane, conducted by Vientiane City council; on-site discussions on how to use ecosystem services to mitigate impacts	Vientiane City council
Thu	12-jan	Travel to Luang Prabang: Meeting with the local authotities, presentation of the two cases	PONRE Luang Prabang
Fri	13-jan	Field observations for two flooding events in Luang Prabang, conducted by Luang Prabang City council; on-site discussions on how to use ecosystem services to mitigate impacts	PONRE Luang Prabang
Sat	14-jan	Weekend	
Sun	15-jan	Weekend – Travel to next destination; Paksan	
Mon	16-jan	Meeting with the Pakxe local authorities, presentation of the two cases. Field observations for two flooding events in Pakxe, conducted by Pakxe City council; on-site discussions on how to use ecosystem services to mitigate impacts. Wrap up with the NDE in Pakxe and travel to Savannakhet.	PONRE Pakxe
Tue	17-jan	Meeting with the Savannahket local authorities, presentation of the two cases. Field observations for two flooding events in Savannakhet, conducted by Savannakhet City council; on-site discussions on how to use ecosystem services to mitigate impacts. Travel to Thakhek	PONRE Savannakhet
Wed	18-jan	Meeting with the Thakhek local authorities, presentation of the two cases. Field observations for two flooding events in Thakhek, conducted by Thakhek City council; on-site discussions on how to use ecosystem services to mitigate impacts. Travel to Paksan	PONRE Thakhek
Thu	19-jan	Meeting with the Paksan local authorities, presentation of the two cases. Field observations for two flooding events in Paksan, conducted by Paksan City council; on-site discussions on how to use ecosystem services to mitigate impacts. Travel to Vientiane and DHI team to leave Laos.	PONRE Paksan
Fri	20-jan	DK team arriving in DK	

Annex 2 Questionnaire/form for describing flooded areas

Assessment of flooded areas

City name:		District:	
Address/Site:		Number of people directly affected:	
Number of other people affected:			
Map (From e.g. Google Earth)			
Frequency of flooding:		Typical duration:	
Typical impacts:			..
Impacts specially related to Ecosystem services			
Important infrastructure elements? (Water works, transformation station, phoneline hub etc?			
Rough estimate of % impermeable area in the flooded area			
Type of water in the flooding: From sewers, from surface			
Distance to green infrastructure elements (e.g. parks, gardens, sports fields, etc) and name(s)			

Assessment of flooded areas: EXAMPLE:

City name: Vientienne		District: Downtown	
Address: Rue Setthathilath		Number of people directly affected: 1300	
Number of other people affected: + 5000, using the street for daily transport			
Map (From e.g. Google Earth)  			
Frequency of flooding:	2-3 times/year	Typical duration:	1-5 days
Typical impacts:	Transport through the area is not possible during the flooding	Houses along the flooded area are damaged and people living there cannot come and go as they are used to	..
Impacts specially related to Ecosystem services	Fruit trees along the street may be damaged if the flooding takes more than 2 days	Gardens are destroyed	Snakes and smaller mammals may die
Important infrastructure elements? (Water works, transformation station, phoneline hub etc?	The telephone connections are broken	Water supply system damaged and polluted water is entering the supply system	
Rough estimate of % impermeable area in the flooded area	70%		
Type of water in the flooding: From sewers, from surface	Most of the water comes up through the sewers while the rest comes from the area around the flooded site because the flooded site is like a depression.		
Distance to green infrastructure elements (e.g. parks, gardens, sports fields, etc) and name(s)	The nearest park is along the river, about 500 meters to the south. Chao Anouvong Park		

Annex 3 Data request sheet

Data Access Matrix: Updated 2 August 2016
A: Readily available, F: Free data access (no costs), P: Payment necessary, N: Not available, Dx: Data available after x months

Data	Importance E: essential S: supporting	Vientiane	Luang Prabang	Bolikhamxay, Paksan	Khammouan, Thakhek	Savannakhet	Champasak, Pakse	Responsible authority	Other information
Topographic information									
Topographical data for cities[1]	E	x	x	x	x	x	x	Monre Land Planning	Topo maps used as background maps for land planning
Topographical data for water shed	E	x	x	x	x	x	x	Monre Land planning	Grid size not available
Hydro-meteorological data:									
Precipitation/evaporation	E	3	1	2	2	3	3	Meteorological Dept, Climate	One main station per city plus xx substations
Temperature	S	x	x	x	x	x	x	Meteorological Dept, Climate	Data available at a price.
Wind	S	x	x	x	x	x	x	Meteorological Dept, Climate	Flow: 40K KIP/year/station
Water level and flow in Mekong River[2]	E	x	x	x	x	x	x	Meteorological Dept, Climate	All other data: 20K KIP/year/station
Water level and flow in other rivers affecting the cities	E							Meteorological Dept, Climate	Main trib. In the cities
Maps of previous flooding events caused by Mekong[3]	S							MONRE Land planning	General flooding maps for typical/annual events

[1] Digital terrain models, DTM
[2] 2-3 decades at the least
[3] Extent of flooding events shown on maps

Data	Importance E: essential S: supporting	Vientiane	Luang Prabang	Bolikhamxay, Paksan	Khammouan, Thakhek	Savannakhet	Champasak, Pakse	Responsible authority	Other information
Maps of previous flooding events caused by heavy rain in the cities/rural areas[4]	S								
Data on flooding impacts on religious sites or sites important to tourism[5]	S								
Urban planning									
Plans and activities related to urban planning and climate change[6]	E	(x)	(x)	(x)	(x)	(x)	(x)	Min. Public works, Dept Housing & Urban planning	Mainly data from master plans for the cities. Most data in hardcopy. To check with local authorities.
Vulnerability maps (cities)	S						x	Min. Public works, Dept Housing & Urban planning	Check UN-Habitat study on Pakse
Vulnerability maps rural	S							?	
Records of damages in previous flooding events	S						x	Min. Public works, Dept Housing & Urban planning	Check UN-Habitat study on Pakse
Land use maps									
Forests, agriculture, soil classification, crop types	S	x	x	x	x	x	x	MONRE Land planning Dept	Available in digital format. Request from Monre to dept. for data.
Spatial information									
Satellite images	E	x	x	x	x	x	x	MONRE Land planning Dept	
Remote sensing data (additional), cities/catchment	S	x	x	x	x	x	x	MONRE Land planning Dept	
Population distribution									

[4] Damages (extend and costs) on e.g. housing, transportation, agriculture, tourism, fishing, access to forest areas etc.
[5] E.g. temples, museums, old part of cities. Flood marks, flood extent, flood duration etc.
[6] Descriptions and reports

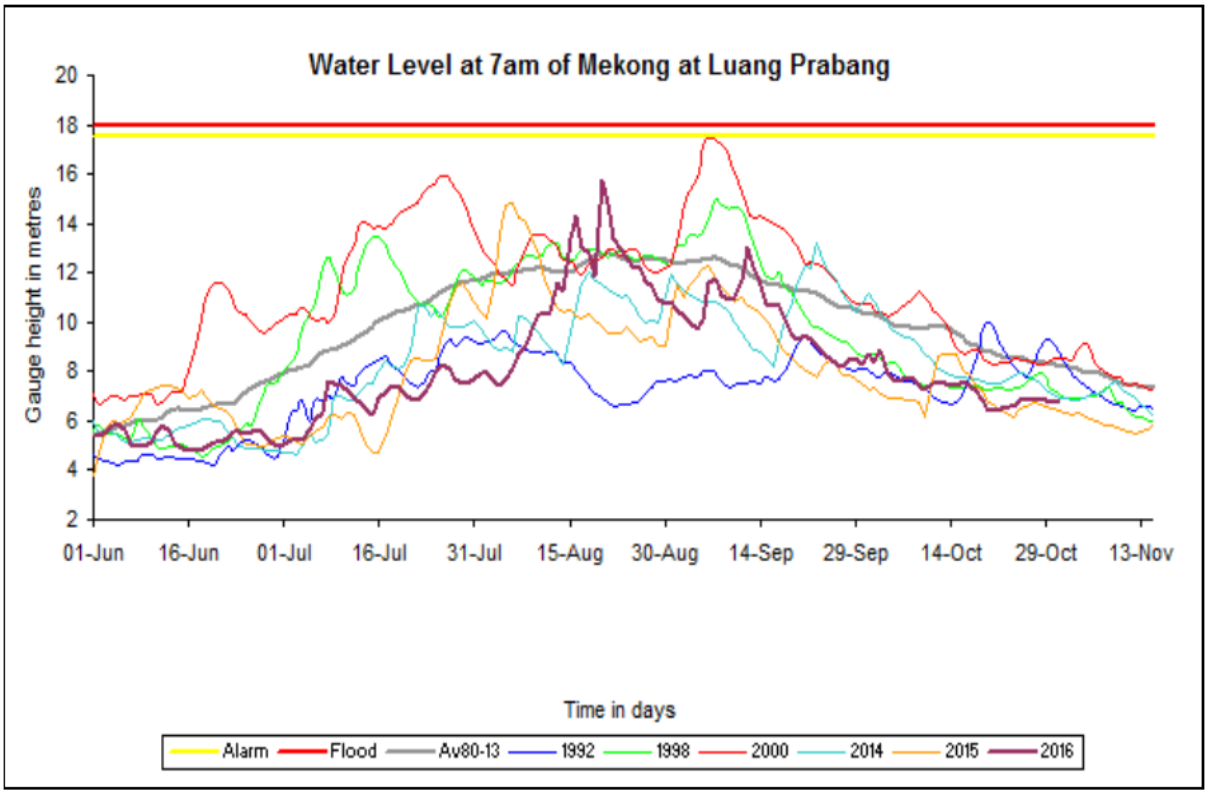
Data	Importance E: essential S: supporting	Vientiane	Luang Prabang	Bolikhamxay, Paksan	Khammouan, Thakhek	Savannakhet	Champasak, Pakse	Responsible authority	Other information
Urban classification (Housing/industry/parks/ other)	E							Local city authorties	May be part of masterplans.
Rural classification (Housing, industry, national parks, other)	S							(Monre Land planning ??)	To be assessed
Infrastructure									
Map of water supply utilities, incl. distribution area	E							Min Public Works, Dept. Water Supply plus local authorities	Dept. Not visited.
Map of wastewater utilities, incl. serviced area	E							Min Public Works, Dept. Water Supply, plus local authorities	Dept. not visited
Other structures: Retention basins, controlled flooding areas etc.	E		x					Min Public Works, Dept. Water Supply plus local authorities	Dept. not visited. LPB has a drainage plan. Authority to be asked

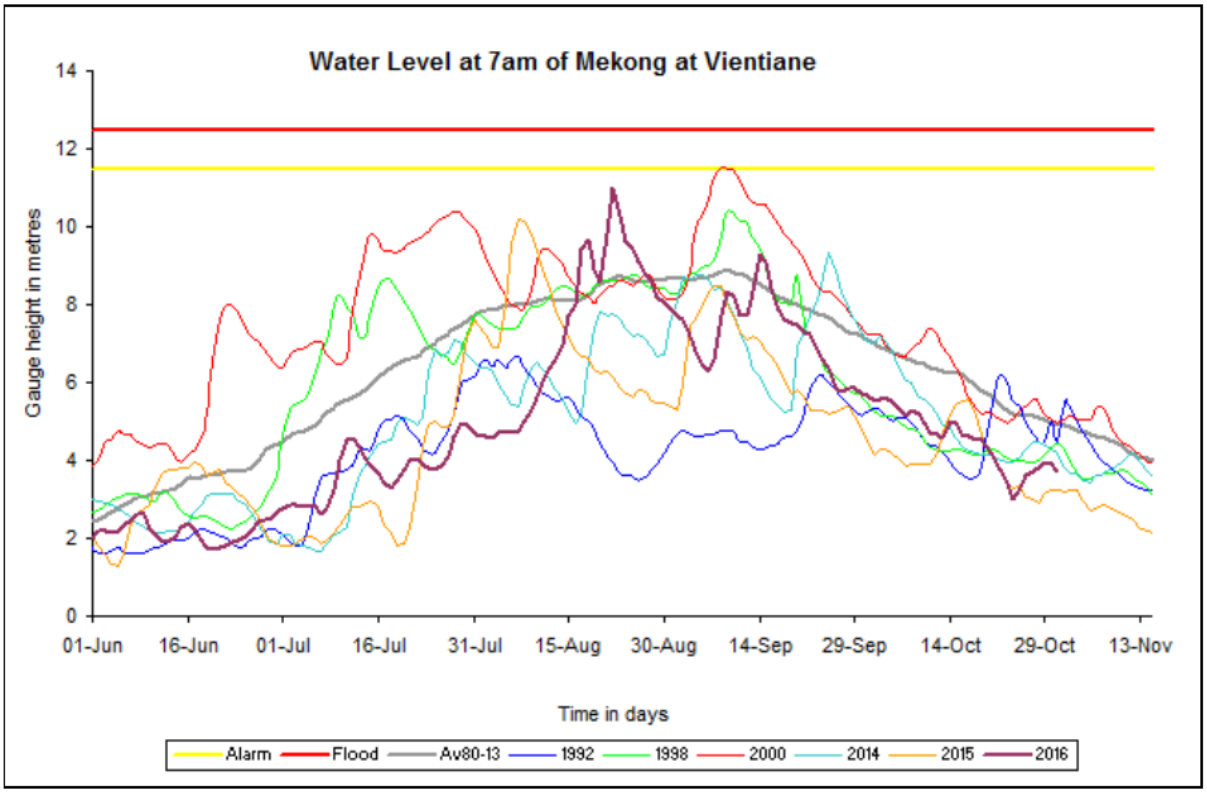
Annex 4 Photos

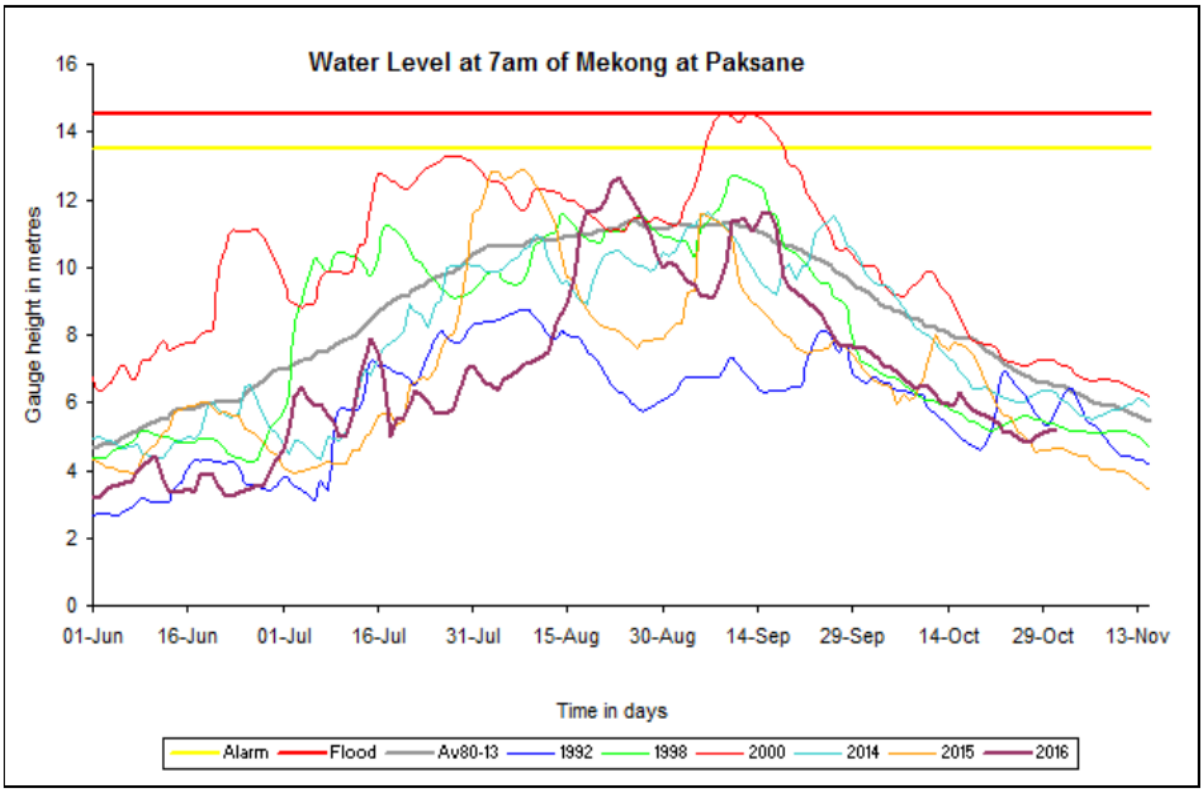
Annex 5 Attendance sheets, consultations

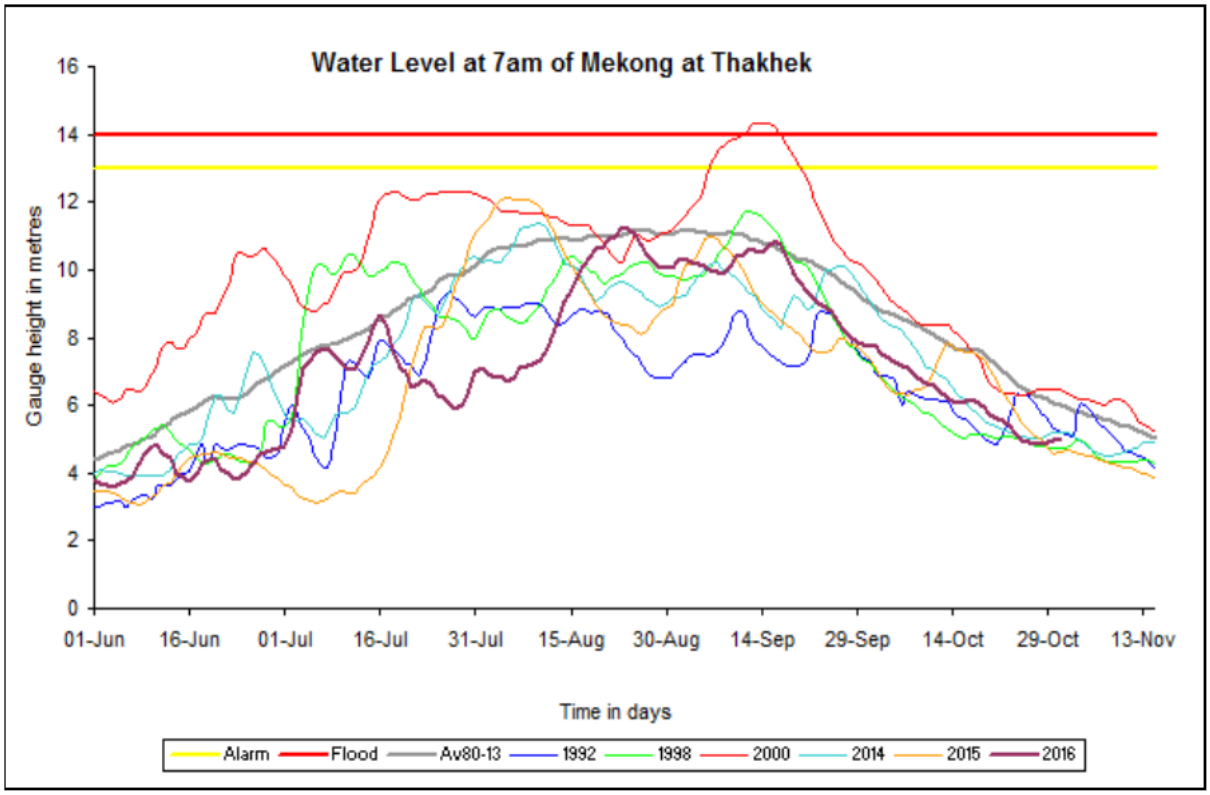
(to be scanned and inserted)

Annex 6 Hydrographs from Mekong River at six sites in Laos


Water Level at 7am of Mekong at Luang Prabang
Gauge height in metres
20
18
16
14
12
10
8
6
4
2
01-Jun
16-Jun
01-Jul
16-Jul
31-Jul
15-Aug
30-Aug
14-Sep
29-Sep
14-Oct
29-Oct
13-Nov
Time in days
Alarm
Flood
Av80-13
1992
1998
2000
2014
2015
2016


Water Level at 7am of Mekong at Vientiane
Gauge height in metres
14
12
10
8
6
4
2
0
01-Jun
16-Jun
01-Jul
16-Jul
31-Jul
15-Aug
30-Aug
14-Sep
29-Sep
14-Oct
29-Oct
13-Nov
Time in days
Alarm
Flood
Av80-13
1992
1998
2000
2014
2015
2016


Water Level at 7am of Mekong at Paksane
Gauge height in metres
0
2
4
6
8
10
12
14
16
01-Jun
16-Jun
01-Jul
16-Jul
31-Jul
15-Aug
30-Aug
14-Sep
29-Sep
14-Oct
29-Oct
13-Nov
Time in days
Alarm
Flood
Av80-13
1992
1998
2000
2014
2015
2016


Water Level at 7am of Mekong at Thakhek
Gauge height in metres
0
2
4
6
8
10
12
14
16
01-Jun
16-Jun
01-Jul
16-Jul
31-Jul
15-Aug
30-Aug
14-Sep
29-Sep
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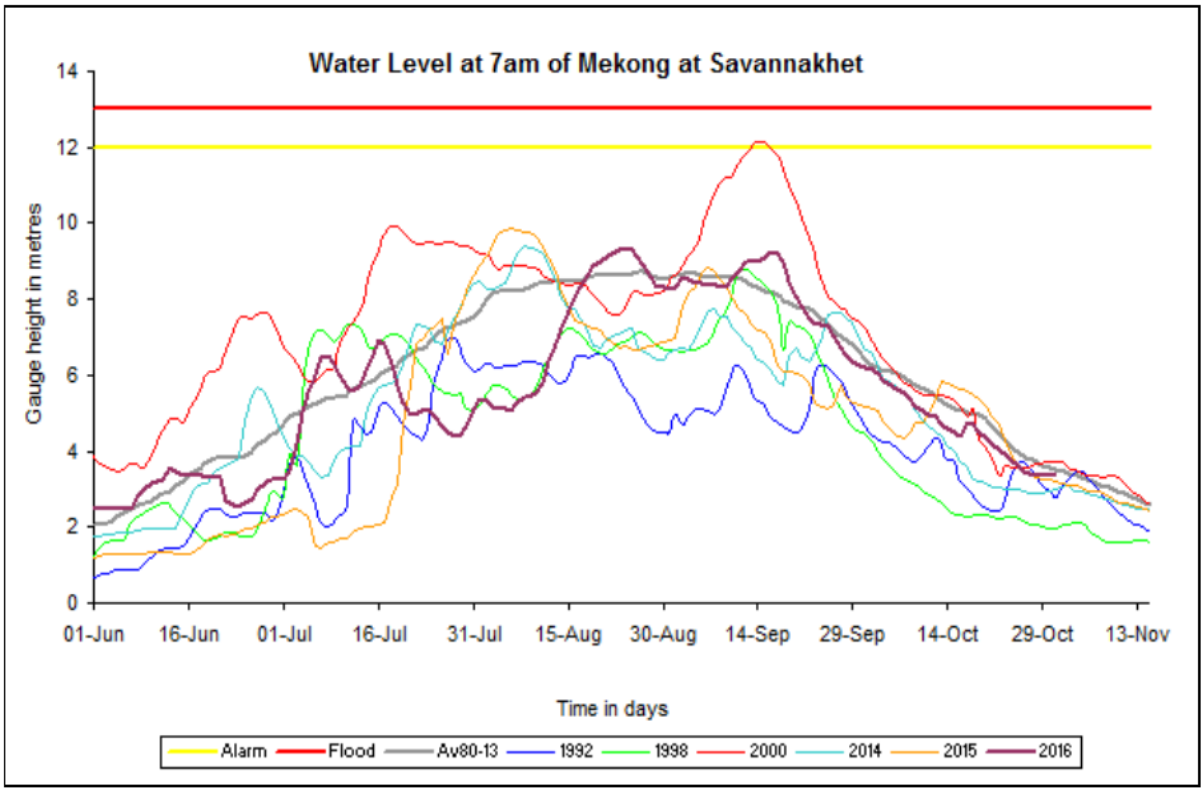
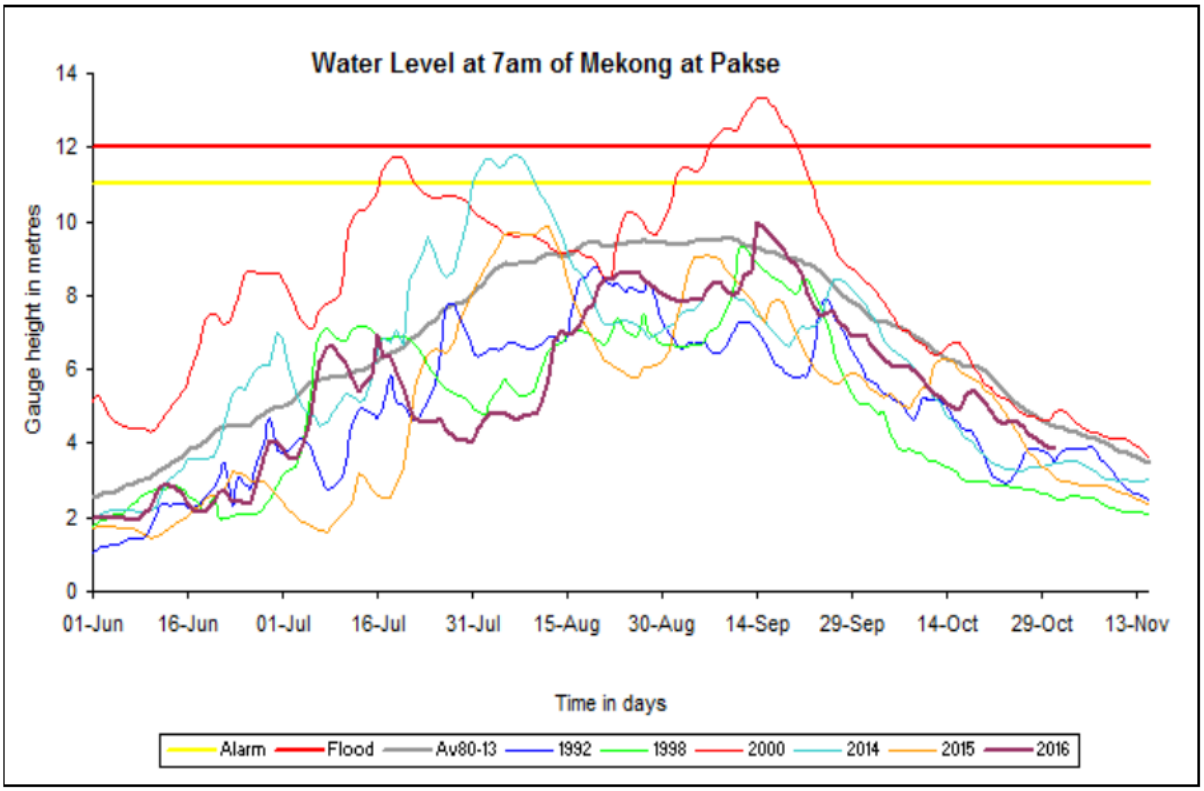
29-Oct
13-Nov
Time in days
Alarm
Flood
Av80-13
1992
1998
2000
2014
2015
2016


Water Level at 7am of Mekong at Savannakhet
Gauge height in metres
0
2
4
6
8
10
12
14
01-Jun
16-Jun
01-Jul
16-Jul
31-Jul
15-Aug
30-Aug
14-Sep
29-Sep
14-Oct
29-Oct
13-Nov
Time in days
Alarm
Flood
Av80-13
1992
1998
2000
2014
2015
2016


Water Level at 7am of Mekong at Pakse
Gauge height in metres
0
2
4
6
8
10
12
14
01-Jun
16-Jun
01-Jul
16-Jul
31-Jul
15-Aug
30-Aug
14-Sep
29-Sep
14-Oct
29-Oct
13-Nov
Time in days
Alarm
Flood
Av80-13
1992
1998
2000
2014
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2016