Acacia ampliceps on a dike in severely salt-affected land two years after planting. (Jilayus Sommutram)

Planting of Acacia ampliceps to control severely salt-affected land. (Thailand)

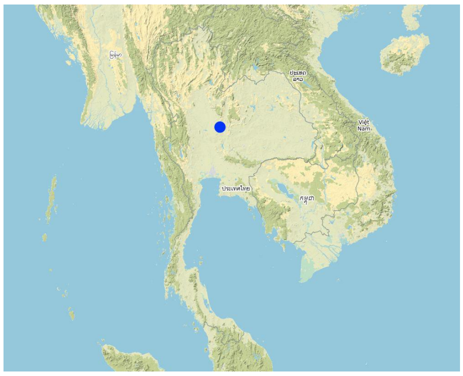
Planting Acacia ampliceps on severely salt-affected land leveled with ditches and dikes.

DESCRIPTION

Acacia ampliceps is a very salt-tolerant species that can grow well in severely salt-affected areas. Land leveling with ditches and dikes is needed, and they are planted along an east-west direction. The technology is very well accepted by land users.

Acacia ampliceps (salt wattle, a leguminous Australian shrub), has been introduced in salt-affected areas in the Northeast of Thailand for the remediation of saline soils. It is a very salt-tolerant plant that grows well on severely salt-affected land. Leveling the land and furnishing with ditches and dikes is needed first, and then the trees are planted in the affected area, along an east-west orientation on the dikes. The technology is very well accepted by land users. Planting such trees in the severely salt-affected land in Kham Tale Sau, Nakhon Ratchasima Province is a subproject of the LDD project on "Planting Perennial Salt-tolerant Trees in Salt-affected Areas in the Northeast of Thailand", which started since 1997. In the subproject, Acacia ampliceps was grown on 68 rai (approx. 11 hectares) covering >50% of the salt patches in heavily salt-affected barren land owned by Mrs. Nurian Tathaisong at Ban Kok Sa-ad Village, Dansay Sub-district, Buayai District, Nakhon Ratchasima Province. In a recent study, after planting the acacia tree in 2015, her land had changed noticeably from its barren state to being covered with trees that provided shade; native grasses had returned to form a source of fodder for her 14 cattle. The purposes of the project have been to maximize the use of the land with a low level of inputs and to decrease salinity to the level that other less salt-tolerant plant species can survive - and crops can be grown for higher income. Eventually it is hoped that better soil properties will be created.
The technology started with locating severely salt-affected sites, leveling the land and furnishing it with ditches and dikes. Each dike is 2 m wide at its base, 0.5 m high, and 1.5 m wide on top. The ditch is 0.5 m deep and 1 m wide. Acacia ampliceps seeds are treated to break the dormancy by soaking in hot water (80°C) for 10 min before planting in the nursery. The 2-month-old seedlings are planted in pits of 0.3 x 0.3x 0.3 metres on the dike, with the addition of 1 kg each of compost and rice husks. Spacing between planting pits is 2 m as a single row in the middle of the dike. According to the land user, 1 year after planting native grasses had returned while the salt crusts had disappeared. At 2-years old, the average plant height was 1.65 m and continued growing, producing 8-10 coppices per tree, and leafy shade for cattle. Acacia ampliceps wood is used to produce charcoal. Three years after planting, the land user had converted 23 rai (approx. 3.7 hectares) of less saline land to paddy fields. After a period of 3 years, the technology induced a better microclimate and richer diversity of flora and fauna species, e.g. wild flowers, native grasses, frogs, dragonflies, earthworms, birds and rats. The fragrant Acacia ampliceps flowers attract bees, thus in the near future the land user intends to undertake apiculture as well as producing essential oil, and making charcoal. The only visible threat to Acacia ampliceps is a forest-fire risk due to its high oil content; fires could cause damage to crops.

LOCATION



Location: Ban Kok Sa-ard, Moo 10 T. Danchang, A. Buayai, Nakhon Ratchasima, Thailand, Nakhon Ratchasima, Thailand

No. of Technology sites analysed: single site

Geo-reference of selected sites
- 100.91431, 15.86977

Spread of the Technology: applied at specific points/ concentrated on a small area

In a permanently protected area?: No

Date of implementation: 2015; less than 10 years ago (recently)

Type of introduction
- [ ] through land users' innovation
- [ ] as part of a traditional system (> 50 years)
- [ ] during experiments/ research
- [x] through projects/ external interventions

The severely salt-affected barren land. (Chakkaphan Phaosrakhu)

Shading and native grasses returned after 3 years of planting Acacia ampliceps. (Chakkaphan Phaosrakhu)

CLASSIFICATION OF THE TECHNOLOGY

Main purpose

- improve production
- ✓ reduce, prevent, restore land degradation
- ✓ conserve ecosystem
- protect a watershed/ downstream areas – in combination with other Technologies
- ✓ preserve/ improve biodiversity
- reduce risk of disasters
- adapt to climate change/ extremes and its impacts
- mitigate climate change and its impacts
- create beneficial economic impact
- create beneficial social impact
- ✓ Desalination

Land use

Land use mixed within the same land unit: No

Unproductive land - Specify: Barren land
Remarks: There are salt crusts in the heavily salt-affected barren land.

Water supply

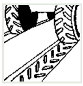
- ✓ rainfed
- mixed rainfed-irrigated
- full irrigation

Purpose related to land degradation

- prevent land degradation
- ✓ reduce land degradation
- restore/ rehabilitate severely degraded land
- ✓ adapt to land degradation
- not applicable

Degradation addressed

chemical soil deterioration - Cs: salinization/ alkalinization



physical soil deterioration - Pc: compaction, Pw: waterlogging

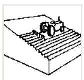
biological degradation - Bc: reduction of vegetation cover, Bq: quantity/ biomass decline, Bl: loss of soil life

water degradation - Hg: change in groundwater/aquifer level

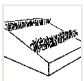
SLM group

- improved ground/ vegetation cover
- desalination

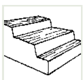
SLM measures



agronomic measures



vegetative measures - V1: Tree and shrub cover



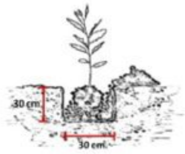
structural measures - S1: Terraces

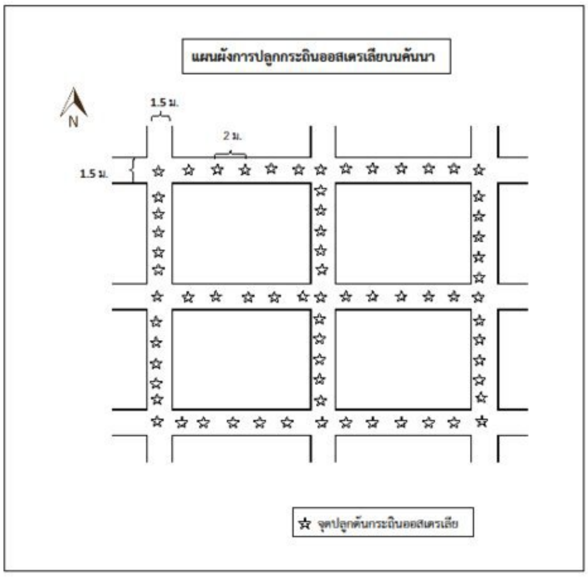
other measures

TECHNICAL DRAWING

Technical specifications

The technologies start with locating severely salt-affected sites and land leveling with ditches and dikes. The dike is 2 m wide, 0.5 m high, the top of the dike is 1.5 m wide. The ditch is 0.5 m deep and 1 m wide. Acacia ampliceps seeds are treated to break the dormancy by soaking in 80°C hot water for 10 min before planting in the nursery. The 2-month-old seedlings are planted in a pit of 0.3x0.3x0.3 m on the dike, with an addition of 1 kg each of compost and rice husk, at a spacing of 2 m as a single row in the middle of the dike. The ridges are 20 m apart.





Author: Chakkaphan Phaosrakhu

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs

- Costs are calculated: per Technology area (size and area unit: **45 rai**; conversion factor to one hectare: **1 ha = 1 ha = 6.25 rai**)
- Currency used for cost calculation: **THB**
- Exchange rate (to USD): 1 USD = 32.0 THB
- Average wage cost of hired labour per day: 300 THB/day

Most important factors affecting the costs

Land Development Department supports the operational budget particularly cost of Acacia ampliceps plantation at first year, then users are in charge of maintenance and forest fire control. At the first year, the initial cost for Acacia ampliceps plantation is about 1,340 THB. This includes: the cost of hired labour on planting process, 600 THB/rai; the cost of young seedlings, approximately 120 THB/rai and the cost of compost, rice husk and chemical fertilizer, about 620 THB/rai. For the expenditure part on the 1st year, there is a hired labour for harvesting fodder in a period of 6 months, approximately 300 THB/rai (from the early to the end of rainy season). However, land user can produce fodder and have grazing land for 14 cattle for around 180 days/yr. Each cattle needs about 30 kg of fodder a day. The cost for the fodder is 1 THB/kg. Land user can save the cost for cattle feeding approx. 5,400 THB/cattle/yr. In conclusion, land user can save the cost for fodder production and grazing land approximately 1,680 THB/rai. For the expenditure part on 2nd and 3rd year, there is fodder harvesting, trimming process and charcoal production. Land users may obtain approx. 10 bags of charcoal that costs 120 THB/bag. Thus, there is a direct income from charcoal production (about 26.7 THB/rai/yr) and an increase of rice production (up to 5%). Land users can have increased income from selling rice at 100 THB/rai. In conclusion, there is a cost of maintenance during 3 years for approx. 900 THB/rai. Part of the income, the land user can have income from the increased rice yield approx. 100 THB/rai/yr. Otherwise, charcoal production can reduce fuel's expenditure in daily life for approx. 26.7 THB/rai/yr. Fodder production and grazing land can reduce cost of cattle feeding for approximately 1,680 THB/rai/yr. The land user, however, wants to leave the branches of Acacia ampliceps for watertable control and for cattle shading.

Establishment activities

1. Nursery of Acacia ampliceps. (Timing/ frequency: May-July)
2. Preparing the pit for planting (Timing/ frequency: May-July)
3. Planting Acacia ampliceps (Timing/ frequency: May-July)

Establishment inputs and costs (per 45 rai)

Specify input	Unit	Quantity	Costs per Unit (THB)	Total costs per input (THB)	% of costs borne by land users
Labour					
Cost of hired labour on planting process (cost of hired labour/ day is 300 THB, 1 rai needs 2 labourers. Hence, the total cost of hired labour is 600 THB)	rai	1.0	600.0	600.0	
Plant material					
Cost of Acacia ampliceps nursery (1 young seedling costs 1.50 THB). 1 rai needs 80 young seedlings. So, the total cost of young seedlings is 120 THB.	seedling	80.0	1.5	120.0	
Fertilizers and biocides					
The cost of compost is 3.5 THB/kg. Rate of application is 0.5 kg/pit	kg	40.0	3.5	140.0	
The cost of rice husk is 4 THB/kg. Rate of application is 1 kg/pit	kg	80.0	4.0	320.0	
The cost of chemical fertilizer (15-15-15) is 20 THB/kg. Rate of application is 0.1 kg/pit	kg	8.0	20.0	160.0	
Total costs for establishment of the Technology				**1'340.0**	
Total costs for establishment of the Technology in USD				*41.88*	

Maintenance activities

1. Forage harvesting after 1 year of Acacia ampliceps plantation (Timing/ frequency: rainy season, 4 times)

Maintenance inputs and costs (per 45 rai)

Specify input	Unit	Quantity	Costs per Unit (THB)	Total costs per input (THB)	% of costs borne by land users
Labour					
Cost of hired labour on trimming process: 1. The cost of hired labour: 300 THB/8-hr day and 2. Trimming process for 1 rai requires 4 hours each time, twice a year. Hence, the total cost of hired labour on trimming process is 300 THB/rai/yr)	time	2.0	150.0	300.0	100.0
Total costs for maintenance of the Technology				**300.0**	
Total costs for maintenance of the Technology in USD				*9.38*	

NATURAL ENVIRONMENT

Average annual rainfall
- ☐ < 250 mm
- ☐ 251-500 mm
- ☐ 501-750 mm
- ☑ 751-1,000 mm
- ☑ 1,001-1,500 mm
- ☐ 1,501-2,000 mm
- ☐ 2,001-3,000 mm
- ☐ 3,001-4,000 mm
- ☐ > 4,000 mm

Agro-climatic zone
- ☐ humid
- ☐ sub-humid
- ☑ semi-arid
- ☐ arid

Specifications on climate
Name of the meteorological station: Meteorological Department

Slope
- ☑ flat (0-2%)
- ☐ gentle (3-5%)
- ☐ moderate (6-10%)
- ☐ rolling (11-15%)
- ☐ hilly (16-30%)
- ☐ steep (31-60%)
- ☐ very steep (>60%)

Landforms
- ☑ plateau/plains
- ☐ ridges
- ☐ mountain slopes
- ☐ hill slopes
- ☐ footslopes
- ☐ valley floors

Altitude
- ☐ 0-100 m a.s.l.
- ☑ 101-500 m a.s.l.
- ☐ 501-1,000 m a.s.l.
- ☐ 1,001-1,500 m a.s.l.
- ☐ 1,501-2,000 m a.s.l.
- ☐ 2,001-2,500 m a.s.l.
- ☐ 2,501-3,000 m a.s.l.
- ☐ 3,001-4,000 m a.s.l.
- ☐ > 4,000 m a.s.l.

Technology is applied in
- ☐ convex situations
- ☐ concave situations
- ☑ not relevant

Soil depth
- ☐ very shallow (0-20 cm)
- ☐ shallow (21-50 cm)
- ☐ moderately deep (51-80 cm)
- ☐ deep (81-120 cm)
- ☑ very deep (> 120 cm)

Soil texture (topsoil)
- ☐ coarse/ light (sandy)
- ☑ medium (loamy, silty)
- ☐ fine/ heavy (clay)

Soil texture (> 20 cm below surface)
- ☐ coarse/ light (sandy)
- ☑ medium (loamy, silty)
- ☐ fine/ heavy (clay)

Topsoil organic matter content
- ☐ high (>3%)
- ☐ medium (1-3%)
- ☑ low (<1%)

Groundwater table
- ☐ on surface
- ☐ < 5 m
- ☑ 5-50 m
- ☐ > 50 m

Availability of surface water
- ☐ excess
- ☐ good
- ☑ medium
- ☐ poor/ none

Water quality (untreated)
- ☐ good drinking water
- ☐ poor drinking water (treatment required)
- ☑ for agricultural use only (irrigation)
- ☐ unusable

Water quality refers to:

Is salinity a problem?
- ☐ Yes
- ☐ No

Occurrence of flooding
- ☐ Yes
- ☐ No

Species diversity
- ☐ high
- ☐ medium
- ✓ low

Habitat diversity
- ☐ high
- ☐ medium
- ✓ low

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

Market orientation
- ☐ subsistence (self-supply)
- ✓ mixed (subsistence/ commercial)
- ☐ commercial/ market

Off-farm income
- ☐ less than 10% of all income
- ✓ 10-50% of all income
- ☐ > 50% of all income

Relative level of wealth
- ☐ very poor
- ☐ poor
- ✓ average
- ☐ rich
- ☐ very rich

Level of mechanization
- ✓ manual work
- ☐ animal traction
- ☐ mechanized/ motorized

Sedentary or nomadic
- ✓ Sedentary
- ☐ Semi-nomadic
- ☐ Nomadic

Individuals or groups
- ✓ individual/ household
- ☐ groups/ community
- ☐ cooperative
- ☐ employee (company, government)

Gender
- ✓ women
- ☐ men

Age
- ☐ children
- ☐ youth
- ☐ middle-aged
- ✓ elderly

Area used per household
- ☐ < 0.5 ha
- ☐ 0.5-1 ha
- ☐ 1-2 ha
- ☐ 2-5 ha
- ✓ 5-15 ha
- ☐ 15-50 ha
- ☐ 50-100 ha
- ☐ 100-500 ha
- ☐ 500-1,000 ha
- ☐ 1,000-10,000 ha
- ☐ > 10,000 ha

Scale
- ☐ small-scale
- ✓ medium-scale
- ☐ large-scale

Land ownership
- ☐ state
- ☐ company
- ☐ communal/ village
- ☐ group
- ☐ individual, not titled
- ✓ individual, titled

Land use rights
- ☐ open access (unorganized)
- ☐ communal (organized)
- ☐ leased
- ✓ individual

Water use rights
- ☐ open access (unorganized)
- ☐ communal (organized)
- ☐ leased
- ☐ individual

Access to services and infrastructure

		1	2	3	
health	poor			✓	good
education	poor			✓	good
technical assistance	poor			✓	good
employment (e.g. off-farm)	poor			✓	good
markets	poor			✓	good
energy	poor			✓	good
roads and transport	poor			✓	good
drinking water and sanitation	poor			✓	good
financial services	poor			✓	good

IMPACTS

Socio-economic impacts

		1	2	3	4	5	6	7	
Crop production	decreased					✓			increased
crop quality	decreased					✓			increased
fodder production	decreased						✓		increased
fodder quality	decreased						✓		increased
animal production	decreased					✓			increased
wood production	decreased					✓			increased
forest/ woodland quality	decreased					✓			increased
non-wood forest production	decreased				✓				increased
risk of production failure	increased				✓				decreased
product diversity	decreased						✓		increased
production area (new land under cultivation/ use)	decreased						✓		increased
land management	hindered			✓					simplified
energy generation (e.g. hydro, bio)	decreased				✓				increased
drinking water availability	decreased				✓				increased
drinking water quality	decreased				✓				increased
water availability for livestock	decreased				✓				increased
water quality for livestock	decreased				✓				increased
irrigation water availability	decreased				✓				increased
irrigation water quality	decreased				✓				increased
demand for irrigation water	increased				✓				decreased
expenses on agricultural inputs	increased		✓						decreased
farm income	decreased					✓			increased
diversity of income sources	decreased					✓			increased
workload	increased			✓					decreased

Socio-cultural impacts

		1	2	3	4	5	6	7	
food security/ self-sufficiency	reduced					✓			improved
health situation	worsened					✓			improved

		1	2	3	4	5	6	7	
land use/ water rights	worsened				✓				improved
cultural opportunities (eg spiritual, aesthetic, others)	reduced				✓				improved
recreational opportunities	reduced					✓			improved
community institutions	weakened					✓			strengthened
national institutions	weakened					✓			strengthened
SLM/ land degradation knowledge	reduced						✓		improved
conflict mitigation	worsened				✓				improved
situation of socially and economically disadvantaged groups (gender, age, status, ehtnicity etc.)	worsened				✓				improved

Ecological impacts

		1	2	3	4	5	6	7	
water quantity	decreased				✓				increased
water quality	decreased				✓				increased
harvesting/ collection of water (runoff, dew, snow, etc)	reduced				✓				improved
surface runoff	increased				✓				decreased
excess water drainage	reduced				✓				improved
groundwater table/ aquifer	lowered	✓							recharge
evaporation	increased					✓			decreased
soil moisture	decreased					✓			increased
soil cover	reduced					✓			improved
soil loss	increased				✓				decreased
soil accumulation	decreased				✓				increased
soil crusting/ sealing	increased					✓			reduced
soil compaction	increased					✓			reduced
nutrient cycling/ recharge	decreased					✓			increased
salinity	increased						✓		decreased
soil organic matter/ below ground C	decreased					✓			increased
acidity	increased					✓			reduced
vegetation cover	decreased							✓	increased
biomass/ above ground C	decreased							✓	increased
plant diversity	decreased							✓	increased
invasive alien species	increased				✓				reduced
animal diversity	decreased							✓	increased
beneficial species (predators, earthworms, pollinators)	decreased					✓			increased
habitat diversity	decreased						✓		increased
pest/ disease control	decreased				✓				increased
flood impacts	increased				✓				decreased
landslides/ debris flows	increased				✓				decreased
drought impacts	increased					✓			decreased
impacts of cyclones, rain storms	increased				✓				decreased
emission of carbon and greenhouse gases	increased						✓		decreased
fire risk	increased				✓				decreased
wind velocity	increased				✓				decreased
micro-climate	worsened					✓			improved

Off-site impacts

		1	2	3	4	5	6	7	
water availability (groundwater, springs)	decreased				✓				increased
reliable and stable stream flows in dry season (incl. low flows)	reduced				✓				increased
downstream flooding (undesired)	increased				✓				reduced
downstream siltation	increased				✓				decreased
groundwater/ river pollution	increased					✓			reduced
buffering/ filtering capacity (by soil, vegetation, wetlands)	reduced				✓				improved
wind transported sediments	increased				✓				reduced
damage on neighbours' fields	increased				✓				reduced
damage on public/ private infrastructure	increased				✓				reduced
impact of greenhouse gases	increased					✓			reduced

COST-BENEFIT ANALYSIS

Benefits compared with establishment costs

		1	2	3	4	5	6	7	
Short-term returns	very negative					✓			very positive
Long-term returns	very negative							✓	very positive

Benefits compared with maintenance costs

		1	2	3	4	5	6	7	
Short-term returns	very negative						✓		very positive

Long-term returns — very negative / very positive: ✓ very positive

Plantation cost in the 1st year is the main cost; the rest is the maintenance cost after 1-2 years of the growing period, including weed control. All kinds of weed can be used for raising animals. Hence, there is not much maintenance cost after establishing the Acacia trees.

CLIMATE CHANGE

Climate-related extremes (disasters)

	not well at all – very well
drought	✓ (2nd of 5)
forest fire	✓ (3rd of 5)
land fire	✓ (3rd of 5)
flash flood	✓ (3rd of 5)

Other climate-related consequences

	not well at all – very well
extended growing period	✓ (2nd of 5)
reduced growing period	✓ (2nd of 5)

ADOPTION AND ADAPTATION

Percentage of land users in the area who have adopted the Technology

- [ ] single cases/ experimental
- [ ] 1-10%
- [x] 11-50%
- [ ] > 50%

Of all those who have adopted the Technology, how many have done so without receiving material incentives?

- [ ] 0-10%
- [x] 11-50%
- [ ] 51-90%
- [ ] 91-100%

Number of households and/ or area covered

4,665 rai (approx. 745 ha)

Has the Technology been modified recently to adapt to changing conditions?

- [x] Yes
- [ ] No

To which changing conditions?

- [ ] climatic change/ extremes
- [ ] changing markets
- [ ] labour availability (e.g. due to migration)
- [x] Acacia ampliceps plantation

The farmer attempted to grow Acacia ampliceps on the leveled land with two methods. The first one: 1) To grow by removing the plastic bag and 2) To grow without removing the plastic bag. The farmers found that removing the plastic bag before planting is better, as the plant growth will not be disrupted.

CONCLUSIONS AND LESSONS LEARNT

Strengths: land user's view

- 1) Desalination to 40% after 3 years of planting;
- 2) Branches of Acacia ampliceps are used as forage and for producing charcoal;
- 3) The plants provide shade, with increased air humidity, resulting in a better atmosphere to live in; and
- 4) The plants increase the amount of flora, especially the forage crop.

Strengths: compiler's or other key resource person's view

- 1) Desalination, thus preventing the spread of salt-affected soil;
- 2) To increase rice yield and, thus, farmers' income;
- 3) To induce better microclimate and biodiversity of both flora and fauna species, e.g. wild flowers, native grasses, frogs, dragonflies, earthworms, birds and rats.

Weaknesses/ disadvantages/ risks: land user's viewhow to overcome

- One year after Acacia ampliceps planting, farmers had to investigate their technology, to prevent their technology from animal and fire attack. 1) The farmer had to investigate his technology, to prevent their technology from trapping animals. They have to build firebreak.
- None 2) The farmer should request his neighbors who raise buffalos and cows to prevent their animals from destroying the technology.

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's viewhow to overcome

- Farmers who do not join this project do not know how to plant Acacia ampliceps on farm dikes. Moreover, they do not know where to buy the seeds. Thus, LDD officers or farmers who are engaged with this project have to inform them. LDD officers or farmers who are engaged with this project have to educate other farmers.

REFERENCES

Compiler
Chakkaphan Phaosrakhu

Editors

Reviewer
Samran Sombatpanit
Rima Mekdaschi Studer
William Critchley

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Last update: Jan. 7, 2021

Resource persons
Nurean Tathaisong - land user
Chakkaphan Phaosrakhu - SLM specialist
Phatranit Chuaysanoi - SLM specialist
Kaewjai Oechaiyaphum - SLM specialist
Saowanee Prachansri - SLM specialist
Apisit Phiprakon - SLM specialist
Prasit Prawanna - SLM specialist
somsri arunin - National consultant

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_4149/
Video: https://player.vimeo.com/video/303220527

Linked SLM data
n.a.

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Institution
- Land Development Department (Land Development Department) - Thailand

Project
- Decision Support for Mainstreaming and Scaling out Sustainable Land Management (GEF-FAO / DS-SLM)

Key references
- Land Development Department: http://www.ldd.go.th/ LDD project on planting perennial salt-tolerant trees in salt-affected areas in Northeast Thailand, Mr. Pramote Yamklee,2005
- LDD project on planting perennial salt-tolerant trees in salt-affected areas in the Northeast. Thailand, Mr. Pramote Yamklee,2005: http://www.ldd.go.th/Lddwebsite/web_ord/Technical/HTML/Technical03030.html

Links to relevant information which is available online
- where the land is greener - Case Studies and Analysis of Soil and Water Conservation Initiatives Worldwide: https://www.wocat.net/library/media/27/
- where people and their land are safer - A Compendium of Good Practices in Disaster Risk Reduction (DRR) (where people and their land are safer): https://www.wocat.net/en/projects-and-countries/projects/drr