Distribution of Saline Soils in the Khorat Basin of Thailand
— preliminary findings —

by

Somsri Sinanuwong* and Yoshikazu Takaya**

Abstract

The Khorat basin of Northeast Thailand is divisible into five categories with respect to the surface salinity: 1) elevated ground underlain by saline Mesozoic rocks, 2) heavily salt-affected lowland, 3) moderately salt-affected lowland, 4) slightly salt-affected lowland, and 5) non-saline. These five zones are shown in Fig. 1.

Introduction

A previous report 1) showed that the salt deposited seasonally by groundwater emerging in the Khorat basin comes from shale and sandstone of the Mesozoic Mahasarakam Formation. The salt-bearing rocks release salt through erosion and weathering, and the salt released is accumulated in lower elevations. The present report shows the areal distribution of i) salt-retaining elevated areas and ii) salt-affected lowland, the latter being further divided into three zones by the degree of salinity.

I Method of study

Visible saline evidence such as salt encrustations and halophytic plants were traced and mapped. Beside this surface information, profile studies of chloride content (by silver nitrate) were made by augering and sampling of natural outcrops, to ascertain the vertical distribution of salt. The results reveal that saline subsoils are often detectable even in areas where no visible evidence of salinity exists on the ground surface. All these surface and subsurface data were plotted on the cross sections of Figs. 2 to 35.

The salinity of unvisited areas was assessed by extrapolating the field data on the cross sections by means of geomorphological interpretation, with the help of the 1 : 50,000 topographical maps, 2) soil maps 3-5), and a geological map. 6) The salt distribution map of Fig. 1 was prepared in this way. This is a first approximation subject to revision when more detailed information is available.

II Mapping unit

Elevated ground composed of saline Mesozoic rocks is “salt-releasing”, while lowlands,

* Department of Land Development, Thailand
** The Center for Southeast Asian Studies, Kyoto University, Japan
which are either eluvial or alluvial plains, are “salt-receiving”. Upland and lowland are thus separated into entirely different categories.

Salt is released from saline rocks throughout the year, but it remains in the subsoil during the wet season and appears on the ground surface only during the dry season. The surface salinity is thus seasonal, controlled by the monsoonal cycle. Though the salinity is most serious in the middle of dry season, only this situation is considered in this paper. The following mapping units and their descriptions are all based on this mid-dry season situation.

i) **Reality salt-affected lowland**

This is an area in which salt encrustations are common or even abundant and the salt content is comparatively high throughout the profiles. The land is mostly devoted to rice farming, but many salt patches are left uncultivated because of their strong salinity. In those particularly strongly salt-affected areas, clumps of thorny bushes such as *Nam daeng* (Maytenus mekongensis), *Nam prom* (Carissa cochinchinensis) and *Nam phi* (Azima savmentosa), of which *Nam daeng* is a very good halophytic indicator, are characteristically dominant. In some swale portions, black colored ground surfaces of Solonchak type are also occasionally seen. Geologically speaking, this unit corresponds to the eluvial valley formed along the western margin of the basin, close to “salt-releasing” higher ground.

ii) **Moderately salt-affected lowland**

Salt encrustations are seen scatteredly but not significant. They appear mostly in a form of small patches along the marginal zone of “salt-releasing” higher ground. This zone is for the most part free from salt encrustations, but saline subsoils are often encountered within 1 m below the ground surface. This land is mainly devoted to rice farming and a feature of the landscape is the occurrence of many isolated Dipterocarpus trees. Most eluvial valleys except for these on the western margin of the basin, which is the heavily salt-affected zone, fall within this unit.

iii) **Slightly salt-affected lowland**

Salt encrustations are rare or absent, and saline subsoils are also not common in this unit. But groundwater, as found in shallow wells and ponds, is in most cases more or less saline. Geologically the unit nearly corresponds to the Recent alluvial valleys of the Chi and Mu rivers. All the land in this unit, except for active floodplains which are left wooded, is covered by paddy fields with sparcely scattered clumps of trees of various kinds.

iv) **Elevated ground composed of saline rocks**

This unit comprises elevated ground underlain by saline Mesozoic rocks. Comparison with the existing geological map reveals that the unit nearly coincides with the Mahasarakam Formation. Since there is always a cover of vegetation and surface layers about 1 m thick are composed of leached material, visible evidence of salinity is not common on the natural ground surface. But along gullies and road cuts, evidence such as streaks of sublimated salt and *Nam daeng* columns are often observed. Sometimes, fresh outcrops of salt retaining shale and sandstone, whose salt content is high enough to be readily tasted, can be en-
countered.

\textit{v) Non-saline area}

This is the area in which no saline indications are found.

\section*{III Cross section}

Selected cross sections are shown in Figs. 2 to 35. Symbols used in the profiles are as follows:

- × Salt crust
- Saline rocks
- Alluvium
- □ Non-saline rocks

\textit{Auger} Auger hole: chloride content is checked by silver nitrate at 20 cm intervals; the degree of the reaction is shown by such abbreviations as:

\begin{itemize}
  \item v v v we; very very very weak reaction
  \item v v we; very very weak reaction
  \item v we; very weak reaction
  \item we; weak reaction
  \item md; moderate reaction
  \item st; strong reaction
\end{itemize}

\textit{pond} pond or stream whose salt content is checked; in the case of pond, the ground water level is also recorded

In the description following abbreviation is used

yl: yellow br: brown gr: gray H: heavy C: clay S: sand Li: light L: loam

\section*{References}

1) Somsri and Takaya, 1974. “Saline Soils in Northeast Thailand; their possible origin as deduced from field evidence” Tonan Ajia Kenkyu (Southeast Asian Studies) Vol. 12, No. 1, Kyoto Univ.
2) U. S. Army Map Service, 1961 Topographical map of 1/50,000, Map series L 708.

\section*{Acknowledgements}

This report is the result of a joint field survey of one month by Thai soil scientists and a Japanese geomorphologist, as part of the work program of the Committee for Coordinating

\footnote{for the detail refer the authors’ previous paper}
Investigations of the Lower Mekong Basin (Mekong Committee). Messrs. Manop Tan-tatemeya and Rungsun Im-Erb, Soil and Water Conservation and Management Division, Land Development Department of Thailand, were with the authors during whole the survey period.

The authors are grateful to the following experts for their instructive comments and advices; Messrs. Anunt Komes, Ying and Phichet Isarangura of the Land Development Department, Messrs. Sangop Kaewbaidhoon, Charoen Phiancharoen, Thawat Jepekeset and Miss Angoon Hongnusonthi of the Mineral Resources Department, and Messrs. W. J. van Liere, D. Workman, Roem Purnariksha and T. Kawai of the Mekong Committee.

This report is published by kind permission of Mr. Bancherd Balankura, Director General of Land Development Department, and Mr. W. J. van der Oord, Executive Agent of the Mekong Committee.

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Localities shown in Fig. 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>K</td>
<td>Khon Kaen</td>
</tr>
<tr>
<td>L</td>
<td>Kalasin</td>
</tr>
<tr>
<td>M</td>
<td>Mahasarakam</td>
</tr>
<tr>
<td>C</td>
<td>Chaiyaphum</td>
</tr>
<tr>
<td>N</td>
<td>Nakhonratchasima</td>
</tr>
<tr>
<td>R</td>
<td>Roi Et</td>
</tr>
<tr>
<td>B</td>
<td>Buriram</td>
</tr>
<tr>
<td>1</td>
<td>Ban Non Tao Lek</td>
</tr>
<tr>
<td>2</td>
<td>Ban Lao Ya</td>
</tr>
<tr>
<td>3</td>
<td>Ban Dung Niam</td>
</tr>
<tr>
<td>4</td>
<td>Amphoe Chiang Yun</td>
</tr>
<tr>
<td>5</td>
<td>Ban Nong Phak Waen</td>
</tr>
<tr>
<td>6</td>
<td>Peak 222 m</td>
</tr>
<tr>
<td>7</td>
<td>Ban Hong Hi</td>
</tr>
<tr>
<td>8</td>
<td>Amphoe Kamalasai</td>
</tr>
<tr>
<td>9</td>
<td>Ban Nong Soeng</td>
</tr>
<tr>
<td>10</td>
<td>Ban Nong Sa Pheng</td>
</tr>
<tr>
<td>11</td>
<td>Amphoe Kosum Phisai</td>
</tr>
<tr>
<td>12</td>
<td>Ban Hua Khua</td>
</tr>
<tr>
<td>13</td>
<td>Ban Tha Ngam</td>
</tr>
<tr>
<td>14</td>
<td>Amphoe Thawat Buri</td>
</tr>
<tr>
<td>15</td>
<td>Amphoe Selaphum</td>
</tr>
<tr>
<td>16</td>
<td>Amphoe Channabot</td>
</tr>
<tr>
<td>17</td>
<td>Amphoe Ban Phai</td>
</tr>
<tr>
<td>18</td>
<td>Amphoe Borobu</td>
</tr>
<tr>
<td>19</td>
<td>Ban Non Muang</td>
</tr>
<tr>
<td>20</td>
<td>Amphoe Wapi Pathum</td>
</tr>
<tr>
<td>21</td>
<td>Ban Khwao Noi</td>
</tr>
<tr>
<td>22</td>
<td>Amphoe Chaturaphak Phiman</td>
</tr>
<tr>
<td>23</td>
<td>Amphoe Kaset Wisai</td>
</tr>
<tr>
<td>24</td>
<td>Ban Ngo</td>
</tr>
<tr>
<td>25</td>
<td>Ban Na Yai</td>
</tr>
<tr>
<td>26</td>
<td>Amphoe Suwannaphum</td>
</tr>
<tr>
<td>27</td>
<td>Ban Khok Kaeo</td>
</tr>
<tr>
<td>28</td>
<td>Ban Krasang</td>
</tr>
<tr>
<td>29</td>
<td>Amphoe Tha Tum</td>
</tr>
<tr>
<td>30</td>
<td>Ban Ku Phra Ko</td>
</tr>
<tr>
<td>31</td>
<td>Ban Tha</td>
</tr>
<tr>
<td>32</td>
<td>Ban Rawiang</td>
</tr>
<tr>
<td>33</td>
<td>Amphoe Ban Han Dan Khum Thot</td>
</tr>
<tr>
<td>34</td>
<td>Ban Non Rawinag</td>
</tr>
<tr>
<td>35</td>
<td>Ban Kut Tha Lat</td>
</tr>
<tr>
<td>36</td>
<td>Amphoe Chaturat</td>
</tr>
<tr>
<td>37</td>
<td>Ban Kan Hong</td>
</tr>
<tr>
<td>38</td>
<td>Amphoe Non Thai</td>
</tr>
<tr>
<td>39</td>
<td>Amphoe Ban Kham</td>
</tr>
<tr>
<td>40</td>
<td>Amphoe Non Sung</td>
</tr>
<tr>
<td>41</td>
<td>Ban Nong Tha Yom</td>
</tr>
<tr>
<td>42</td>
<td>Ban Si Suk</td>
</tr>
<tr>
<td>43</td>
<td>Ban Samrong</td>
</tr>
<tr>
<td>44</td>
<td>Ban Don Muang</td>
</tr>
<tr>
<td>45</td>
<td>Ban Wat</td>
</tr>
<tr>
<td>46</td>
<td>Ban Ya Kha</td>
</tr>
<tr>
<td>47</td>
<td>Ban KM O</td>
</tr>
<tr>
<td>48</td>
<td>Ban Nong Ya Khao</td>
</tr>
<tr>
<td>49</td>
<td>Amphoe Phutthaisong</td>
</tr>
<tr>
<td>50</td>
<td>Amphoe Phayukkhaphum Phisai</td>
</tr>
<tr>
<td>51</td>
<td>Ban Nong Kheng</td>
</tr>
<tr>
<td>52</td>
<td>Ban Yang Si Surat</td>
</tr>
<tr>
<td>53</td>
<td>Amphoe Satuk</td>
</tr>
</tbody>
</table>
Fig. 1 The Salt distribution in the Khorat basin
Outcrop

0.0-0.2 m: purplish dark gr L; no R
-0.7 m: do, but with profuse pink quartz and more compact; v v v we R
-(0.8 m): lense of shell, charcoal, earthenware and animal bone fragments
-0.8 m: Mn·pisolith accumulation; v v v we R
-1.0 m: dark gr C with profuse yl mottings, common lateritic concretions and few Ca·nudules;
we R
-2.0 m+: yl and white SL; indulated; we R

Fig. 2 Cross section (1-8)

Fig. 3 Cross section (2-9)
Fig. 4 Cross section ②-④

Fig. 5 Cross section ①-④
Fig. 6 Cross section ⑥-⑦

Fig. 7 Cross section ⑧-⑩
S. Sinanuwong and Y. Takaya: Distribution of Saline Soils in the Khorat Basin of Thailand

Fig. 8 Cross section 1-4

Outcrop 1
0.0-0.3 m: br gr L with few Fe-concretions; no R
-0.7 m: do v we to we R
-0.8 m: aggregation of Fe-concretions and rock fragments
-1.2 m: weathered red br shale; we to md R

Outcrop 2
0.0-0.7 m: br gr L with profuse pink quartz; no R
-0.8 m: do; v v v we R
-1.2 m: pisolitic laterite; v we to we R
-1.4 m: gr and yl mixed SC, indurated; we to md R
-1.8 m+: bluish gr gravel and sand; we R

Fig. 9 Cross section 5-11
Fig. 10 Cross section Β–Ω

Fig. 11 Cross section Ω–Θ

Outcrop

0.0–0.5 m: gr L with few pisoliths; no R
-0.7 m: gr br L with many br mottlings; no R
-1.2 m: bluish gr C with many br red lateritic mottlings; no R
-1.5 m: mixture of gr C and pink quartz with common br mottlings; no R
water: no R

Fig. 12 Cross section Θ–Θ
Fig. 16 Cross section @-@'

Outcrop

0.0-0.3 m: pinkish gr fine S; v v v we R
-0.4 m: br gr compact fine S; v v v we R
-0.7 m: gr fine S; v v v we R
-0.8 m: lateritic pan
-1.3 m: pinkish gr CL; we R
-1.8 m: yl gr S; v v we R

Fig. 17 Cross section @-@'

Outcrop

0.0-0.1 m: gr L. with profuse Mn-pisoliths; v v we R
-0.7 m: white to br gr S; v v we R
-0.75 m: Mn-pisolith accumulation; v v we R
-1.2 m: yl, gr, pink and white mixed S; v we R
-2.3 m: blue and gr mixed C; indurated; we to md R
S. SINANUWONG and Y. TAKAYA: Distribution of Saline Soils in the Khorat Basin of Thailand

Fig. 18 Cross section @ @

Outcrop

0.0-0.2 m: gr br very fine S; v v we R
-0.4 m: gr br L; v we R
-0.5 m: do; we R
-0.7 m: Fe-concretion accumulation; we R

Fig. 19 Cross section @ @

Fig. 20 Cross section @ @
Outcrop

- 0.0-0.15 m: gr and yl mixed L; no R
- 0.2 m: Fe- and Mn-pisolith accumulation; no R
- 0.8 m: gr LC with few reddish br mottlings; no R
- 1.3 m: pink, gr and br mixed SL; v v we R
  water: v v we R

Fig. 21 Cross section ①②③

Fig. 22 Cross section ①②③

Fig. 23 Cross section ①②③
Cross sections of 35 38 and N-38-39 have been reported in Somsri and Takaya (1974)

**Fig. 24** Cross section @ @

**Fig. 25** Cross section @ @

**Fig. 26** Cross section @ @

Outcrop
- 0.0–0.3 m: very dark brown gr HC; no R
- 0.6 m: br gr HC; md R
- 0.65 m: Mn-pisolith accumulation; md to st R
- 0.95 m: mixture of Ca-nodules and kaoline clay; md to st R
- 1.3 m: kaoline clay with Ca-nodules and br red mottlings; md to st R
- 1.7 m: red br shale; md to st R

S. SINARUWONG and Y. TAKAYA: Distribution of Saline Solis in the Khorat Basin of Thailand
Outcrop

- 0.0-0.1 m: yl br very fine S with few pisolith; no R
- 0.2 m: dark gr very fine S; no R
- 0.5 m: pink quartz sand; no R
- 0.6 m: aggregation of Mn-pisolith and rock fragments; no R
- 1.6 m: br red shale; v we to md R

Fig. 27 Cross section @-@

Fig. 28 Cross section @-@

Fig. 29 Cross section @-@
Fig. 30 Cross section

Fig. 31 Cross section

Fig. 32 Cross section

S. SINANUWONG and Y. TAKAYA: Distribution of Saline Soils in the Khorat Basin of Thailand
**Fig. 33** Cross section @-@

**Fig. 34** Cross section @-@

**Fig. 35** Cross section @-@