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REGULAR RESEARCH ARTICLE

Soil mapping by farmers in a Thai-Lao village in Northeast Thailand: A test of an ethnopedological research method

Sujitra Yodda [1, 2], Suwit Laohasiriwong [1], and A. Terry Rambo [1, 2, *]

AFFILIATIONS

1. Program on System Approaches in Agriculture for Sustainable Development, Department of Agricultural Extension and Agricultural Systems, Faculty of Agriculture, Khon Kaen University, Khon Kaen, Thailand
2. Soil Organic Matter Management Research Group of Khon Kaen University, Khon Kaen, Thailand

Correspondence: trryrambo@yahoo.com

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ABSTRACT

Having farmers draw soil maps of their communities has been frequently advocated as a faster, cheaper alternative to scientific soil surveying in developing countries. However, research on the extent to which farmers share common mental soil maps and the extent to which these match scientific maps is lacking. In this study, 11 Thai-Lao farmers were individually asked to draw maps showing the location of different types of soil in their village, and two groups of four farmers each were assembled to draw soil maps collectively. The maps were very different from each other and the extent to which they matched scientific categorizations of village soils was low. The maps of the individual farmers depicted two to five types of soil occupying two to seven zones. The map of one group depicted two types of soil in two zones, while the map of the other group depicted four types of soil in seven zones. When the soil zones on the maps drawn by the individual farmers were compared with scientific categorization of the soils at 26 sampling points, agreement was low, with an average of 11.6 full and partial matches. The performance of the group maps was not necessarily better: One group map had no full matches and only five partial matches while the other group map had 19 full and partial matches. In view of this heterogeneity in the soil knowledge of community members, ways must be found to identify the most knowledgeable farmers to draw the maps if farmer soil mapping is to be a useful research tool. This study found that the maps drawn by individuals who have had worked as hired laborers on plots in many parts of their village were generally more reliable than those drawn by farmers who had only worked on their own plots.

KEYWORDS
Indigenous soil knowledge; farmer soil maps; ethnopedology; mental maps; paddy soils

1. INTRODUCTION

Asking farmers in rural communities in developing countries to draw maps of the soils in their villages is a commonly used method in ethnopedological research (Trung et al., 2008). This method is heavily relied on by participatory rural appraisal (PRA) researchers (Payton et al., 2003). Some researchers have also compared the maps drawn by the villagers with scientific soil maps (Barrera-Bassols et al., 2006a). It has often been suggested that soil maps drawn by farmers can be a valuable tool for devising land use management plans for rural communities in developing countries in Africa, Asia, and Latin America where small-scale scientific soil maps are rarely available. It is thought that having farmers draw their own soil maps is likely to be quicker and cheaper than carrying out scientific soil surveys (Barrera-Bassols et al., 2009, Cools et al., 2003).

Researchers have employed two different methods to generate these soil maps. The most commonly used approach is to have groups of villagers draw them as a collective exercise in a community meeting (e.g., Barrera-Bassols et al., 2006a; Nethononda &

Odhiambo, 2011; Payton et al., 2003; Saleque et al., 2008: 363). This approach was employed by Payton et al. (2003: 363) in their research in East Africa. They reported that: "The initial cognitive participatory mapping of local soil types during the PRA started with the farmers drawing a free-hand village administrative map on the ground. Typically, this was done by a relatively large (20–25), middle aged to elderly group of mixed gender. This was transferred onto paper and farmers then drew boundaries of the locally named soil types in pencil. After further group discussion and agreement about soil categories and boundaries a corrected LK [local knowledge] soil map was produced."

An alternative approach is inviting a small number of local "experts" believed to be especially knowledgeable about soil to work together with the researchers to draw the maps (e.g., Schuler et al., 2006; Trung et al., 2008). This approach was employed by Trung et al. (2008: 30) in their study of the indigenous soil knowledge of the Muong ethnic group in a hamlet in northern Vietnam.

They reported that: "...local soil and field experts (two village officials who had received some training about soils from the government and nine farmers who they thought were knowledgeable about agricultural practices) [to] drew maps about land-use conditions at their locality in order to have an overall view on the distribution of soils and their relationship with topography."

Schuler et al. (2006: 445-446) also relied on "local soil experts" in their study comparing farmer and scientific soil maps in a Black Lahu community in northern Thailand." They began their study by identifying: "...farmers with long-term practical experience. Next, key informants were asked which soil types they distinguish and by which differentiating criteria. Soil classification was further refined during field walks with farmers. The key informants ranked different soil properties and developed a local soil classification and a local soil map. The topics for ranking, e.g., suitability for crop production, fertility, infiltration rate, available water capacity, erodibility, and stickiness were suggested by us. In a final step, the farmers showed the distribution of the local soil units on a print-out of the topographic map."

Both approaches have sometimes been supplemented with participatory walks along transects of the farmers' fields and/or checking the accuracy of maps with individual farmers in their fields (e.g., Cools et al., 2003).

The maps generated by either of these data collection approaches have been presented as being accurate reflections of the shared knowledge of community members about the spatial distribution of soils in their locality (Barrera-Bassols et al., 2009). The underlying assumption of these studies is that all the farmers in a village share common knowledge about the types of soil and the locations of these different soils in their community's landscape. This assumption of homogeneity of soil knowledge within communities has not been empirically tested, however. It is possible that collective mapping exercises may obscure differences among individual farmers and produce maps that do not accurately represent the location of soils in the community. Unfortunately, the existence of any differences in views about the spatial distribution of different types of soil among informants is rarely mentioned in research reports and then only in passing. For example, Schuler et al. (2006:446) reported that in their participatory soil mapping in northern Thailand most of the farmers distinguished only two soil types: 'Black Soil' and 'Red Soil' but "a minority also mentioned texture and water drainage." They concluded that "local soil classification is not always consistent," although they do not provide detailed information about inter-informant variability.

The possibility that all members of the community might not share the same beliefs about the types and locations of soils within their village has simply not been taken into consideration in designing methods for studying the mental soil maps of farmers.

However, because our earlier research on soil naming and classification of Thai-Lao farmers in two villages in Northeast Thailand (Yodda & Rambo 2018; Yodda et al., 2020) had found great heterogeneity in farmer soil knowledge, leading us to conclude that soil knowledge in these villages was "familial microculture" rather than being widely shared within the communities, we suspected that similar variability would be found in farmer knowledge of the spatial distribution of different types of soil. If this was true, then maps drawn as collective exercises would obscure the existence of different views from the group consensus. Unfortunately, however, we have been unable to find any prior research about variations among individual farmers in their mapping of soils. A few researchers have collected data from large samples of farmers, but they have not reported the extent of individual variation. For example, in a study of local soil knowledge in Bangladesh, Payton et al. (2003: 365) conducted "a plot-by-plot interview survey with land-owners about local soil names in 600 rice paddies. These were entered in the GIS tagged by plot location." Because informants were only asked to identify the type of soil in their own plots, this approach did not reveal variations among informants in their knowledge about the distribution of different types of soil in the community.

We have also been unable to identify any previous studies that have compared the soil maps generated in group exercises with those drawn by individual farmers or compared the extent to which maps drawn using these different approaches matched scientific soil maps of the community. To help fill these gaps in knowledge, we carried out research in a Thai-Lao wet rice farming village in Northeast Thailand in which we: 1) had 11 farmers individually draw soil maps of their community; 2) assembled two groups composed of four farmers each to draw collective soil maps; and 3) collected soil samples from all parts of the paddy field toposequence for laboratory analysis of their texture. In this paper, we use the data generated in this research to 1) Assess the extent of heterogeneity in farmer knowledge about the spatial distribution of paddy soils; 2) Compare the soil zones delineated on the maps of the individual farmers with scientific categorization of the texture of soils sampled from multiple sampling points in the village's paddy field area; 3) Compare the maps drawn by two groups of farmers with the maps drawn by the individual farmers; and 4) Identify factors that may influence differences in farmer knowledge of the spatial distribution of soils in their villages.

2. MATERIALS AND METHODS

2.1 Research design

Ethnopedology is the study of soil knowledge of people belonging to different ethnic groups (Barrera-Bassols et al., 2006b). Most ethnopedological studied have been focus on naming and classification of soils. A smaller number of studies have been done on farmer knowledge of the spatial distribution of soils in rural communities. In the present study we have applied the latter ethnopedological method by having farmers in a Thai-Lao village draw maps showing the spatial distribution of soils in their community.

This study was designed to compare the soil maps of their village drawn individually by a sample of 11 farmers with each other as well as with the maps drawn by two groups of farmers. One group ("the expert group") was composed of four farmers with wide experience working on fields in many parts of the village. A second group was composed of four farmers who had already drawn individual maps.

The maps were compared with each other in terms of the number of soil types and the number of zones occupied by these types they depicted. The comparisons were done to assess the extent to which the farmers possessed a common mental map of soils in their village and to explore if maps drawn by groups differed from maps drawn by farmers working individually. The soil zones depicted on these maps were also compared to the points where we had collected soil samples to determine the extent to which the farmer identification of soils matched the laboratory analysis of the texture of the samples.

2.2 Selection of the study site

This study was carried out in Non Ku village (latitude 16∘30'37" N and longitude 102∘39'56" E), Sawathee sub-district, Mueang district, Khon Kaen province (Figure 1). The authors had previously studied Soil naming and classification by farmers in this village (Yodda and Rambo, 2018). Non Ku was selected as the study site because almost all of its 434 inhabitants belonged to the Thai-Lao ethnic group, spoke the Lao language, and shared a common cultural background, and engaged in growing rainfed wet rice as their main agricultural activity. All the land in the village was classified on the Land Development Department 1:100,00 soil series map as belonging to the Roi-Et soil series, which is an ultisol in the USDA soil taxonomy (Ngwe et al., 2012). The first author is also a native of the village, which facilitated interactions with the farmers there. A more detailed description of the study site is provided in Yodda & Rambo (2018).

2.3 Selection of the sample farmers to draw maps

Three samples of farmers were selected to participate in this study: 1) Eleven farmers to individually draw maps; 2) A group of four farmers with wide knowledge of soils in the village to draw a map as a collective exercise; and 3) A group of four farmers who had earlier drawn individual maps to draw a map as a collective exercise. All 11 informants gave their informed consent to participate in this study after being given assurances that their anonymity would be preserved.

2.3.1 Sample of farmers to draw maps individually

The 11 farmers taking part in the individual mapping exercise had previously been selected for a study of their indigenous soil taxonomy (Yodda & Rambo, 2018). The sample included nine men and two women, all of whom were 60 years of age or older, were either born in the village or had lived there for more than 20 years and were actively engaged in rice cultivation.

2.3.2 Selection of the sample of knowledgeable farmers for a group mapping exercise

Four villagers were selected for an "Expert Group" to draw a collective map of village soils. All members had wide experience of soils everywhere in the village, three members held positions of some authority in the village, including a 56-year-old man who was the assistant headman, a 53-year-old woman who was the wife of the headman and leader of the village housewives' group, and a 53-year-old woman who was a village health volunteer. The fourth member was a 63-year-old woman who was known to have transplanted rice in many areas of the village. In its composition this "Expert Group" was similar to the types of villagers often relied on in PRA research.

2.3.3 Selection of sample of farmers who had previously drawn maps individually for a group mapping exercise

A second group, composed of four informants who had previously drawn maps individually, was assembled to draw a collective map. Three members of this group were male, one female, all were 74 years of age or older, three were natives of the village and the other had lived there for more than 40 years, and three had worked as hired laborers on fields in different parts of the village while the other had worked only on fields near to his own field. Two members had drawn the most complex individual maps (in terms of the number of different soil types depicted) and two had drawn the simplest individual maps.

2.4 Farmer drawing of maps of the location of different types of soil in the village

During January 2016, each of the 11 informants was individually asked to draw the boundaries of the areas occupied by different types of soil on a print-out of a 1:20,000 Google Earth satellite image of the village. In February 2022, the researchers presented each of the two groups with identical copies of the Google satellite image and observed how they produced their collective maps.

2.5 Soil sampling

As part of an earlier study on soil naming and classification by farmers in Non Ku village (Yodda &Rambo, 2018), 16 soil samples were collected during January 2016 from the paddy fields of the 11 informants. In February 2022, 10 additional samples were taken from areas of the village that had not been included in the initial sample. A handheld GPS receiver was used to record the coordinates of the plot where the sample was taken. Nine sub-samples were taken from the top 15 cm of the soil in each plot and mixed into a single composite sample. The samples were then air dried before storing in transparent plastic bags. The samples were sent to the laboratory of the Agriculture Development Research Center of Northeast Thailand of the Faculty of Agriculture, Khon Kaen University, which analyzed their sand, silt and clay contents and categorized them according to their texture

2.6 Assessing the extent of agreement among the maps drawn by the farmers

A grid of 300 cells was overlain on each map and the type of soil found within each of 30 randomly selected cells identified. The number of different names assigned by all the informants to the soil in each cell was then calculated.

2.7 Comparing the farmers' maps with scientific categorization of soils at sample points

The 26 points where soil samples had been collected were marked on a map of the village's paddy field area. Each of the soil maps drawn by the 11 individual informants and the two groups was overlaid on this map and the name assigned by the informants to the soil at that point was compared to the scientific categorization of the texture of the soil sample taken from that point. The number of full and partial matches between the soil names assigned to that area by the farmers and the scientific categorizations of the soil at each point was then calculated. A full match was recorded when the informant used the same name as the scientific one while a partial match was recorded in cases where the name used by the farmer was only slightly different from the scientific one, e.g., the farmer labeled the soil as "sandy loam" while the laboratory analysis had categorized it as "loam." If the farmer called it "loamy sand," however, it would not be recorded as a partial match.

2.8 Determining the breadth of knowledge of individual farmers of soils in the village

Every informant was asked about their experience with soils in the whole village, e.g., had they only worked on their own field, had they worked as hired laborers on neighboring fields, had they worked as hired laborers on fields in different parts of the village, or had they collected wild crabs from paddy fields in various parts of the village.

3. RESULTS

3.1 Characteristics of the soil maps drawn by individual farmers

Comparison of the maps drawn individually by the 11 informants revealed that they did not share a common mental map of the spatial distribution of different types of soil in the village. Their maps varied in both the number of soil types they displayed and their delineation of the boundaries of the zones occupied by the various types of soil. The maps of three farmers showed only two types of soil, four maps showed three types, three maps showed four types and one map showed five types of soil. In contrast, the laboratory analysis of the texture of soils from the 26 sampling points identified seven types of soil: sand, loamy sand, sandy loam, loam, silt loam, clay loam, and clay. The maps also varied greatly in the number and boundaries of zones occupied by different types of soil they depicted. Three maps displayed only two zones, two maps had three zones, four maps had four zones, one map had five zones and one map had seven zones. Figure 2 presents the maps drawn by the farmers.

A comparison of the names assigned on the farmers' maps to the soil within the 30 randomly selected cells in a 300-cell grid revealed a lack of consensus among informants about the spatial distribution of different types of soil. All informants assigned the name din sai (sandy soil) to the soil in 10 of the cells, but there was less agreement about other cells: Five cells had between two and four names each, nine cells had five names each, three cells had six names, two cells had eight names, and one cell was assigned nine different names (data not shown).

Despite the evident heterogeneity of the farmer maps in terms of these quantifiable attributes, careful visual comparison of the maps revealed that all the maps depicted the soil north of a sloping line running from the northwest corner down to approximately the mid-point of the eastern edge as coarse textured sandy soil (din sai). The area to the south of this line was identified on most of the maps as having finer textured soils, although informants variously identified these as being loamy sand, sandy loam, loam, sandy clay, and clay. The level of agreement about the zonal boundary of the area covered by sandy soil was much higher than that regarding the distribution of various types of finer textured soil.

3.2 Characteristics of the maps drawn by the groups

The map drawn by the group of informants who had previously drawn individual maps, showed only two types of soil located in two zones (Figure 3a) while the map drawn by the "Expert Group" of informants who had worked as hired laborers on fields in all different parts of the village showed four types of soil distributed in seven zones (Figure 3b).

The group maps were similar to each other, as well as to the maps drawn by the individual farmers, in showing the soil in the northern and eastern part of the village's paddy fields as being course textured while depicting finer textured soils in the southwestern part.

3.3 Comparison of soil maps drawn by individual farmers with the scientific categorization of village paddy soils

Since no small-scale soil map of Non Ku village has been issued by the Land Development Department we were unable to directly compare the farmer maps with a scientific soil map. However, we were able to compare the laboratory categorization of the textures of the 26 soil samples we had taken from paddy fields in various parts of the village with the types of soil for those points shown on the farmers' maps. This comparison was facilitated by the fact that almost all of the soil names employed by the farmers were based on texture, which was also the basis for the laboratory categorizations of the soil samples.

The level of agreement for the maps drawn by the individual farmers was quite low (Table 1). There were only 34 full matches (out of a possible 286 pairings) with an average per farmer of 3.1 full matches (11.9%). The extent of agreement was higher when both partial matches and full matches were included in the analysis. There were

128 full and partial matches (44.8%) out of the 286 possible matches, for an average of 11.6 matches per farmer.

There was wide variation among the farmers in the extent to which the zones on their maps fully matched the laboratory categorization of soils at the sample points: Three farmers had no full matches, one had one, one had three, five had four, and one farmer had 10 full matches. Similar variability was evident when both their full and partial matches were counted: One farmer had 23 full and partial matches (out of 26 possible matches), two had 19, one had 17, one had 15, one had 12, one farmer had 11, and four farmers had only three full and partial matches.

The level of agreement between the farmer maps and the scientific categorization of the soil samples was higher for sampling points with coarser textured soils (loamy sand and sandy loam), lower for moderately fine textured soils (loam) and higher for clayey soils (Figure 4). Of the 11 sampling points where there was greater than 50% full or partial agreement between the farmer maps and the scientific categorization of texture, 10 were classified as sandy loam and one as loamy sand. Moreover, out of the five sampling points where there was >90% full or partial agreement between the farmer maps and the scientific categorizations, four were categorized as sandy loam and the other as loamy sand.

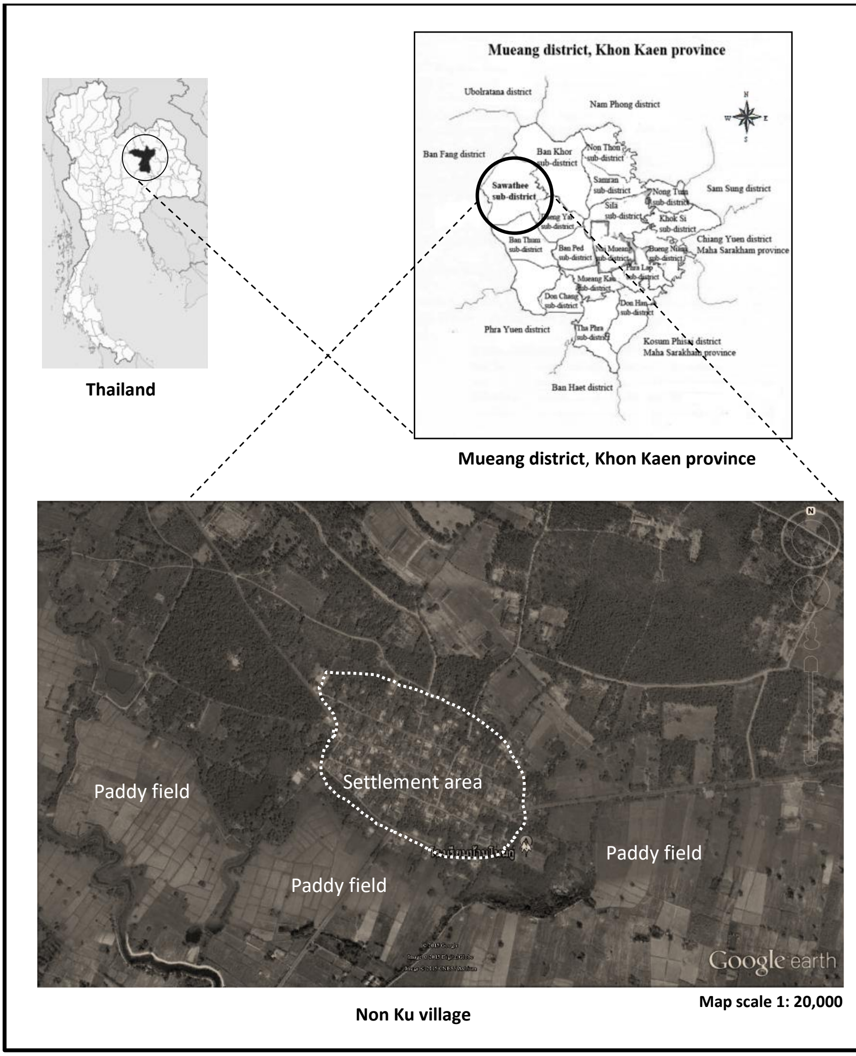
3.4 Comparison of the group maps with the scientific categorization of village paddy soils

The map drawn by the Expert Group did not have any full matches and only five partial matches, (19.2%) with the laboratory characterization of soils at the 26 sampling points. In comparison, the maps drawn by the individual farmers showed an average of 3.1 full matches (11.9%) and 11.6 (44.8%) partial and full matches.

The map drawn by the group of informants who had previously drawn individual maps had four full matches (15.4%) and 15 partial matches (57.7%) out of 26 possible matches, for a total of 19 full and partial matches (73.1%). Thus, the map produced by this group outperformed both the average of the individual maps and the map drawn by the Expert Group. However, on average the individual maps previously drawn by the members of this group had more full matches (4.5) but fewer partial and full matches (9.5) than the map that resulted from their collective effort. Surprisingly, this group map had a lower level of agreement with the scientific categorization of the soils at the sampling points than the highest performing map drawn individually by one of its members, which had 10 full and 23 full and partial matches. In the group meeting, we observed that this very knowledgeable individual mostly acquiesced with the zonal boundaries proposed by other group members and did not strongly advocate her own more complex view of the spatial distribution of soils in the village.

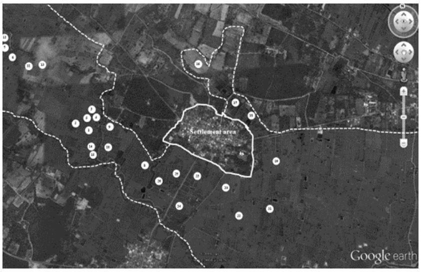
3.5 Influence of the breadth of their experience with village soils on the maps of individual farmers

We classified the 11 farmers who had drawn individual maps into two groups: one group was composed of five farmers whose experience of soils in the village was limited to their own plots or neighboring ones, where some had worked as hired laborers; the other group was composed of six farmers who had worked as hired laborers on fields in many parts of the village, one of these farmers had also collected wild crabs from paddy fields in all parts of the village she used a digging tool (called siam in the local language) to dig out the crabs from their holes, with are often 30 cm deep, so she learned about the texture of soils in these fields. The maps of the farmers who had wide experience had a much higher level of agreement with the scientific categorization of soils at the sampling points (an average 17.3 full and partial matches per farmer) than the maps drawn by the farmers with more limited experience (an average 4.8 full and partial matches per farmer).

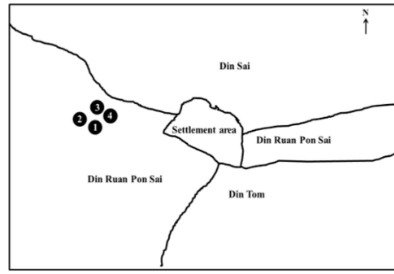


Note on sources of maps: 1) Thailand: https://bit.ly/2FhYJyP; 2) Mueang district: https://shorturl.asia/Yexfv; 3) Non Ku village: drawn by authors on Google Maps image

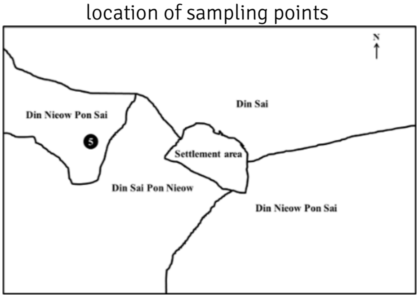
Figure 1. Map showing the location on Non Ku village



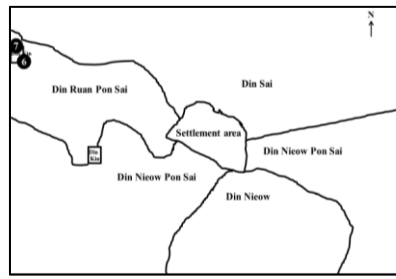
Satellite image of paddy area showing the location of sampling points



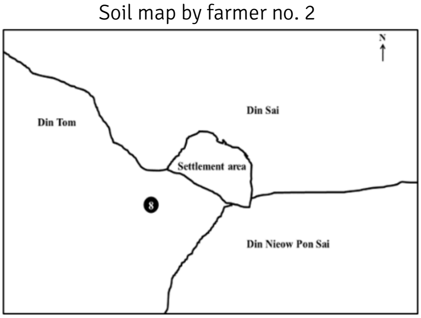
Soil map by farmer no. 1



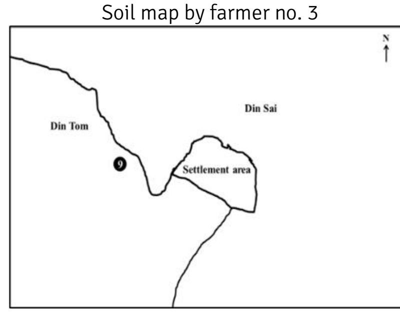
Soil map by farmer no. 2



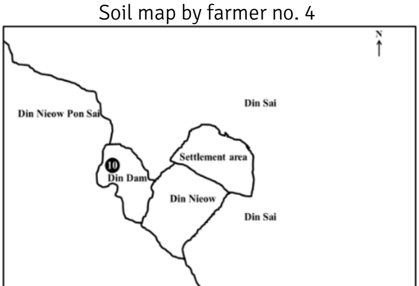
Soil map by farmer no. 3



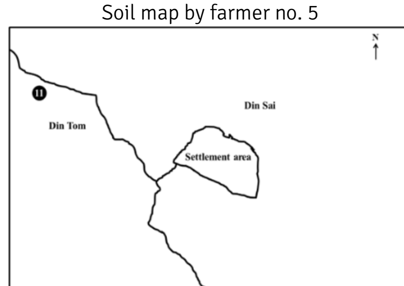
Soil map by farmer no. 4



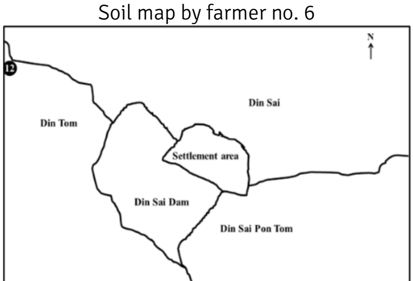
Soil map by farmer no. 5



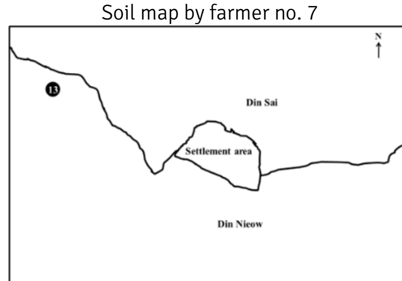
Soil map by farmer no. 6



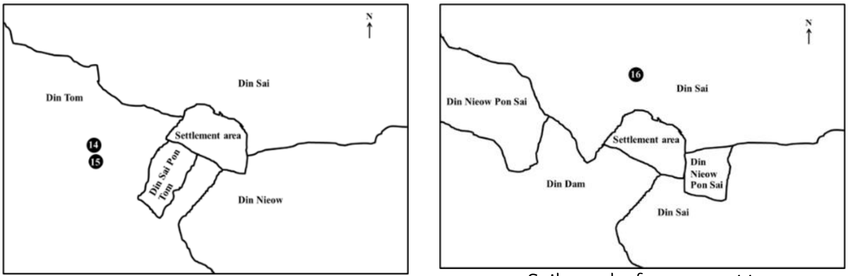
Soil map by farmer no. 7



Soil map by farmer no. 8



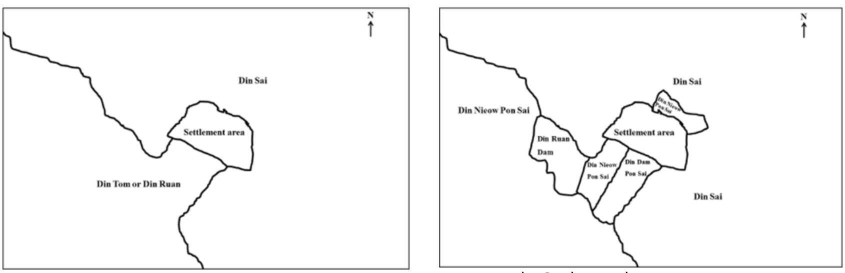
Soil map by farmer no. 9



Soil map by farmer no. 10 Soil map by farmer no. 11

Note: The numbers in the black circles indicate the points where soil samples were collected from the plots of each of the individual farmers

Figure 2. Soil maps drawn by individual farmers



a. Soil map by group of original informants b. Soil map by expert group

Figure 3. Soil maps drawn by groups

4. DISCUSSION

The maps drawn by the farmers, both as individuals and in groups, exhibited considerable diversity in their depiction of the spatial distribution of soil types in the village. Some maps displayed only two or three zones having different types of soil whereas others offered a considerably more complex view, with the most complex map showing seven different zones. It is thus evident that these farmers did not share a single common mental map of the geography of soil in their village. This heterogeneity is not surprising since our earlier research on soil naming and classification by farmers belonging to the Thai-Lao ethnic group (Yodda & Rambo, 2018; Yodda et al., 2020) had revealed a similar heterogeneity in their soil taxonomies. This heterogeneity is a consequence of the enculturation process through which individuals acquired their soil knowledge. Soil knowledge is only transmitted vertically within families, from parents to children, and rarely or never horizontally among friends and neighbors, so that it is a form of familial microculture (Yodda & Rambo, 2018). Hence, even though these farmers live and cultivate paddy fields within the same village, they do not share a common knowledge base about the soils there.

Despite this lack of agreement about the spatial distribution of different types of soil, the farmers appear to share a general perception that soils in the northeastern part of the village have a coarser texture than those in the southern part. This division matches the topography of the paddy fields, with higher elevation fields located in the northeastern part of the village and lower elevation fields in the southern part, as is shown by a northwest-southeast transect of the village (Figure 5). In Northeast Thailand higher elevation paddy fields generally have coarser textured soils than lower-lying ones, which have been enriched with clay deposited by surface run-off from higher elevation areas (Rigg, 1985).

There is a relatively poor fit between the soil zones delineated on most of the maps and the scientific categorization of the texture of soils at the sampling points falling within these zones. The question remains of why the maps of a few farmers more closely matched the scientific categorization of soils in the village. Follow-up interviews, done after we had analyzed the maps, revealed that these differences were associated with differences in the breadth of experience of individual farmers with soils outside of their own plots (Table 2). Six of the seven farmers whose maps had more than 80% agreement with the scientific soil categorizations had had wide experience of soils outside their own plots. This finding fits with the view of Winklerprins (1999) that farmer soil knowledge is derived from direct experience. Consequently, farmers usually have better knowledge of the soil in their own plots, than of soil in more distant fields.

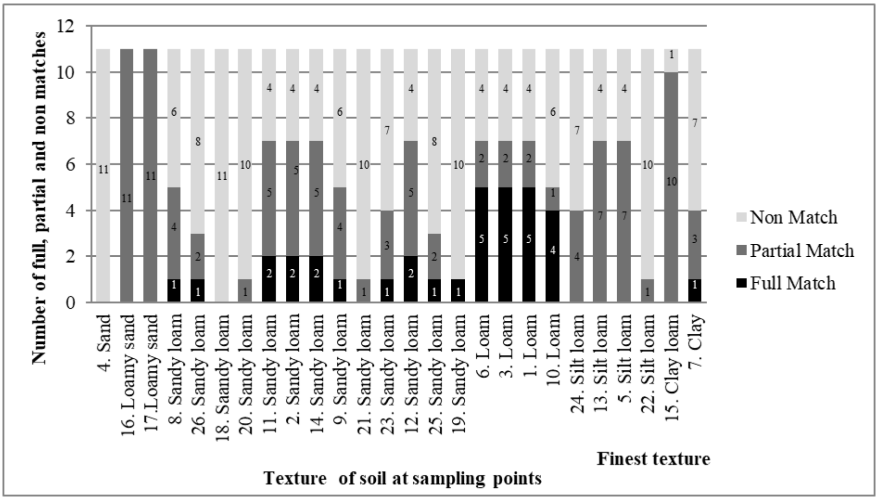


Figure 4. Extent of matching of soil zones on farmers' maps with scientific categorization of textures of soils at sampling points in paddy fields in Non Ku village

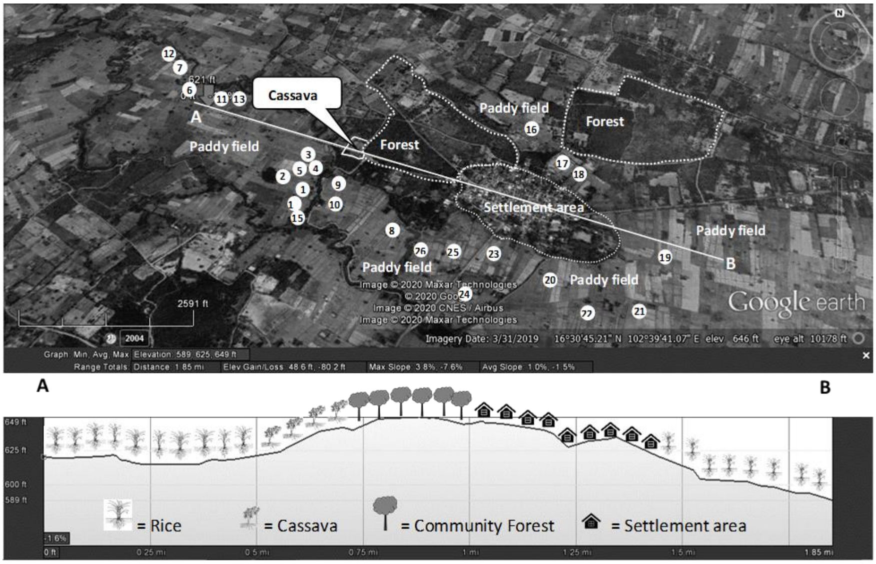


Figure 5. Northwest to southeast transect across the paddy field area of Non Ku village [Source of maps: Google Earth image]

Table 1. Comparison of soil zones delineated on farmer maps with laboratory categorizations of the texture of soils at sampling points within those zones

Matches	Informant no.											Group meeting	
	1	2	3	4	5	6	7	8	9	10	11	The original informants	The new respondents
Number of non matches	3 (11.5)	23 (88.5)	15 (57.7)	7 (26.9)	7 (26.9)	23 (88.5)	11 (42.3)	14 (53.9)	23 (88.5)	9 (34.6)	23 (88.5)	7 (26.9)	21 (80.8)
Number of partial matches	13 (50.0)	3 (11.5)	7 (26.9)	15 (57.7)	15 (57.7)	3 (11.5)	11 (42.3)	9 (34.6)	2 (7.7)	13 (50.0)	3 (11.5)	15 (57.7)	5 (19.2)
Number of full matches	10 (38.5)	0	4 (15.4)	4 (15.4)	4 (15.4)	0	4 (15.4)	3 (11.5)	1 (3.8)	4 (15.4)	0	4 (15.4)	0
Number of partial and full matches	23 (88.5)	3 (11.5)	11 (42.3)	19 (73.1)	19 (73.1)	3 (11.5)	15 (57.7)	12 (46.1)	3 (11.5)	17 (65.4)	3 (11.5)	19 (73.1)	5 (19.2)

Note: The numbers inside the parentheses are the percentages of different names used by each of the respondents

Table 2. Relationship of farmer soil maps with the breadth of their experience with village soils

Number of informants	Age	Gender	Number of zones Shown on map	Number and (percentage) of partial matches	Number and (percentage) of full matches	Number and (percentage) of partial and full matches	Breadth of experience of informants with soils in village[a]
1	83	Female	4	13 (50.0)	10 (38.5)	23 (88.5)	3
2	72	Male	4	3 (11.5)	0 (0.0)	3 (11.5)	2
3	72	Male	7	7 (26.9)	4 (15.4)	11 (42.3)	3
4	68	Male	3	15 (57.7)	4 (15.4)	19 (73.1)	3
5	66	Male	2	15 (57.7)	4 (15.4)	19 (73.1)	3
6	75	Male	4	3 (11.5)	0 (0.0)	3 (11.5)	2
7	72	Male	2	11	4	15	3

Number of informants	Age	Gender	Number of zones Shown on map	Number and (percentage) of partial matches	Number and (percentage) of full matches	Number and (percentage) of partial and full matches	Breadth of experience of informants with soils in village[a]
				(42.3)	(15.4)	(57.7)	
8	78	Male	4	9 (34.6)	3 (11.5)	12 (46.1)	2
9	74	Male	2	2 (7.7)	1 (3.8)	3 (11.5)	1
10	66	Female	4	13 (50.0)	4 (15.4)	17 (65.4)	3 and 4
11	78	Male	5	3 (11.5)	0 (0.0)	3 (11.5)	1

Notes: [a]Breadth of experience of soil of informants: 1. Only worked on own land; 2. Worked as hired laborers on fields near their own field but not elsewhere in the village; 3. Worked as hired laborers on fields in different parts of the village; 4. Collected wild crabs from paddy fields in different parts of the village

Our findings about the relative reliability of maps drawn in group meetings compared to those drawn by individual farmers are inconclusive but seem to favor individual mapping. Thus, the map drawn by the Expert Group, which was composed of the sort of individuals commonly recruited for PRA mapping exercises, had fewer full and partial matches with the scientific categorization of soils at the sampling points than the average of the maps drawn by the individual farmers. The map drawn by the group of farmers who had previously drawn maps individually outperformed the average of the individual maps but had fewer matches than the highest scoring individual map drawn by one of its members. The nature of group dynamics in Thai-Lao villages, as in many peasant communities in Southeast Asia, prioritizes maintenance of harmony and discourages expression if dissenting views, especially by persons of lower social status. Consequently, individuals with superior knowledge of the geography of soils in the village are likely to remain silent if a less knowledgeable but higher status member of the group proposes drawing the map in a way which they think is inaccurate.

5. CONCLUSION

This study has revealed a number of methodological problems associated with farmer soil mapping that raise serious questions about the utility of this ethnopedological research method. It was found that the farmers in Non Ku village did not share a common mental soil map of their community. Although it is not yet known if other ethnic groups display similar heterogeneity , our on-going research in other villages in Northeast Thailand suggests that such heterogeneity in indigenous soil knowledge is widespread. To the extent that heterogeneity in the soil knowledge of individual farmers is a widespread phenomenon, researchers must address the question of how to identify only the most knowledgeable farmers to draw soil maps. Our results suggest that the maps drawn by those individuals who have had wide direct experience working with soils on plots in many parts of their village are likely to be more reliable than those drawn by farmers who have only worked on their own plots.

As this research has revealed, having groups of farmers collectively draw maps in community meetings, as is commonly done in PRA research, does not ensure generation of more reliable maps. Indeed, the tendency of villagers in many rural communities to avoid confrontation with fellow villagers, especially those holding positions of power, is likely to suppress expression of divergent views. If they are to rely on maps drawn collectively in village meetings, researchers must pay close attention to the power dynamics among participants. They must take care to organize mapping exercises in ways that allow individual villagers, regardless of their social status, to freely express their views. Regardless of the method used, however, whether having farmers draw maps individually or collectively in group meetings, identifying informants with wide experience of working with soils in different parts of their communities is essential. It may even be the case that landless agricultural laborers, who have worked on the plots of many different landowners, may be better informants than owners of large farms who have only worked on their own land.

Finally, our research has shown that Thai-Lao farmers possess a wealth of indigenous soil knowledge, including knowledge about the spatial distribution of different types of soil in their communities. Such knowledge is not, however, shared equally by all members of the community. Finding better ways to tap into farmer soil knowledge in all its heterogeneity remains a major challenge for ethnopedological researchers..

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