



ECHO Asia Notes

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ECHO Development Notes

Edited by Abram Bicksler and Daniela Riley

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30th Edition of ECHO Asia Notes

Thank you for taking the time to read this special 30th edition of ECHO Asia Notes!

It is hard to believe that this is the 30th installment of this periodical and that in 7.5 short years, readership has risen to over 2,500 working in most major countries of the Asia Region.

Although the makeup of the ECHO Asia Regional Impact Center has changed over that time, we remain committed to our mission of equipping those who are working with the poor and smallholder farmers of Asia with ideas, information, techniques, and new plants so that they can be more effective in their work.

We believe that God loves the poor and wants us to bless and empower them by sharing sound agricultural and community development processes that are sustainable, just, and God-honoring through our diverse network.

As always, the only reason that the ECHO Asia Network exists is because you are a

part of it, providing feedback, encouragement, questions, and advice so that we can learn with you and amplify these practices around Asia and across the world.

In this New Year, I encourage you to reflect with us on what God has done for us and for the world and this Good News that we share. We hope that the work of ECHO is also good news to you, your work, and to those whom you serve. We look forward to many more years of partnership together with you.

Best regards,

Abram J. Bicksler, Ph.D.
Director, ECHO Asia Impact Center



(L) ECHO team members at our Chiang Mai office. (Above top) Asia Seed Bank location. (Above bottom) Network members visiting our office from Korea.

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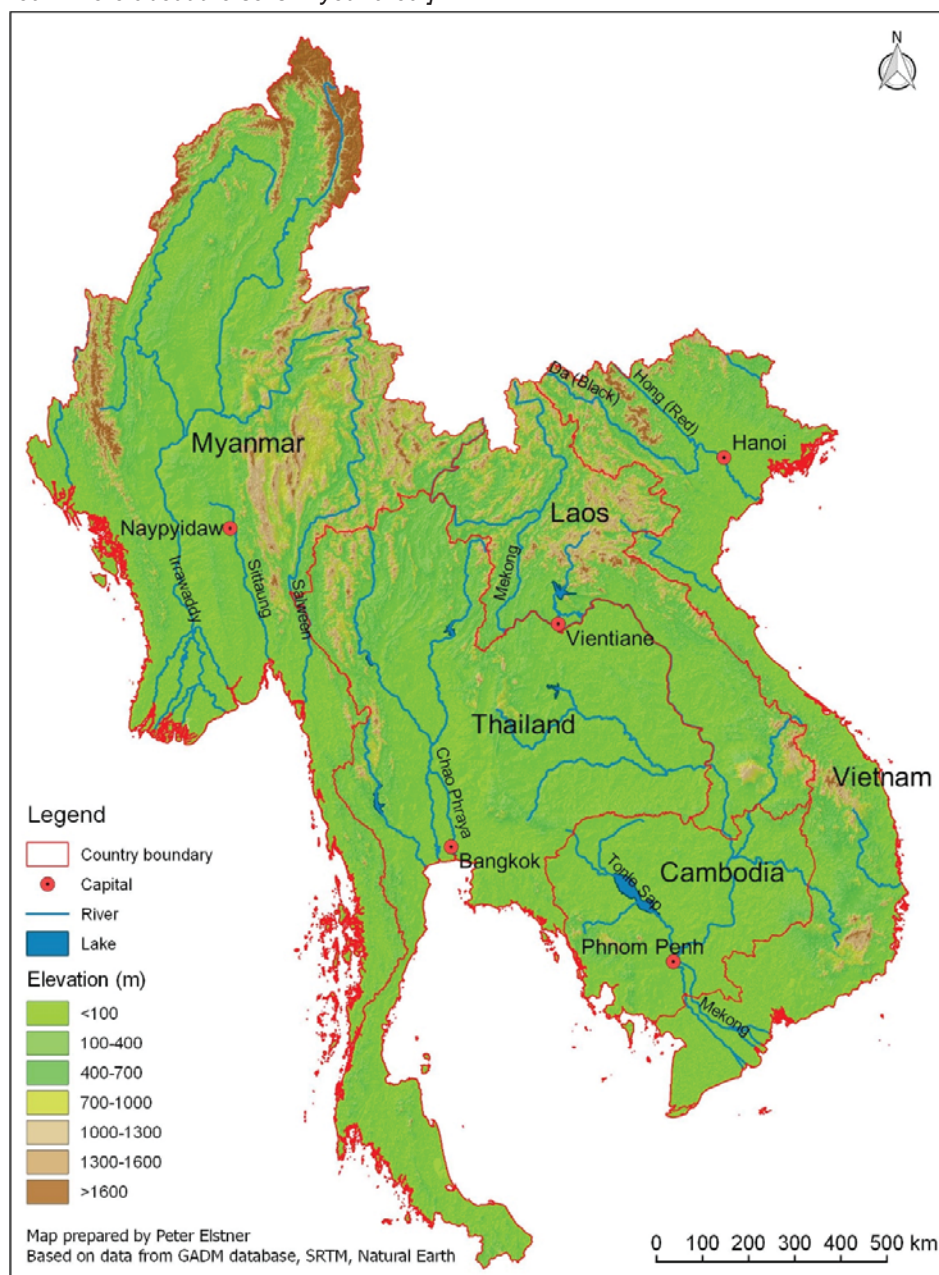
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Soils of Mainland Southeast Asia

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We have been looking for a reference guide to the soils of Southeast Asia for some time, and in the past have had to rely upon the fragmented soil classifications provided by most Southeast Asian countries. Those guides tended to include old data and were certainly not interactive. In this article, Peter Elstner explores the Digital Soil Map of the World and the resulting seven major soil classes of Southeast Asia. Soils are the backbone and foundation for all sustainable agriculture and development, and knowing the type of soil in your community is essential for knowing the types of crops, development, and land use that can occur there. Be sure to check out the Reference Soil Groups (starting on page 7 for more information). We hope that this guide will inspire you to explore the Digital Soil Map and learn more about the soils in your area.]



Map 1: Topographic map of Mainland Southeast Asia (FAO 2007).

General Overview: Soils of Mainland Southeast Asia

This report describes and analyzes the soil distribution and characteristics of the main soil types in Mainland Southeast Asia (MSEA) that comprise the countries of Cambodia, Lao PDR, Myanmar, Thailand, and Vietnam (Map 1).

Geography

Mainland Southeast Asia (MSEA) is characterized by mountain ranges in the north, large plains and plateaus in the south, and large river systems that run from the mountains through the plains to the sea.

The mountains along the border with China stretch mostly from north to south with elevations up to 5,800 meters. These mountains are the source of the large rivers, most importantly the Mekong, which runs through all countries, and the Irrawaddy in Myanmar. Both rivers spread into wide deltas before reaching the sea. Other important rivers are the Chao Phraya River in Thailand, the Salween and Sittoung rivers in Myanmar, and the Red River in Vietnam. Extensive fertile lowland plains along these rivers are highly suited for wet-rice cultivation. The center of Cambodia is dominated by a lacustrine plain formed by the inundations during the flooding of the Tonle Sap (Great Lake).

Climate

The climate in MSEA is normally determined by the monsoon. The cold, dry season from October to February is determined by the northeast monsoon and the hot, wet season from May to September by the southwest monsoon. The inter-monsoon season in March and April is very hot and dry. Rainfalls are influenced by the orientation of main mountain ranges such as the Tenasserim Mountains in eastern Myanmar and the Annam chain in Vietnam (FAO 1979). This means the central zone of Myanmar, Thailand, and Southern Indo-China are located within the rain-shadow region and have a dryer climate.

Average temperatures are nearly uniform (around 27°C) throughout the year in the southern region of MSEA (south of 17°N latitude). Inland areas in the northern region, with increasing latitude, have a yearly average temperature range from 20 to 30°C. These areas also have large variation in mean daily temperatures, due

to their continentality. Increasing altitude also reduces high summer temperatures and humidity. Northern Vietnam, Laos, and the Myanmar Himalayas have a subtropical climate with relatively cold mean temperatures below 15°C in winter (FAO 1979).

Data Sources and Data Availability

The Digital Soil Map of the World from the FAO (2007) provides comprehensive soil data for the whole world. The first version of these data was published in 1979 by FAO. Location, area, and distribution of soil types remain very similar – only the data structure and information were improved. The FAO uses its own soil classification described in the “World Reference Base for Soil Resources” (FAO 2014), most recently updated in 2015. The WRB distinguishes 32 Reference Soil Groups (RSGs), which are the main soil types.

A detailed description of the RSG’s characteristics, management and use can be found in “Lecture Notes on the Major Soils of the World” (FAO 2001), as well as in the “World Reference Base for Soil Resources” (FAO 2014).

A very useful source to visualize and obtain data for soil and soil characteristics is the website SoilGrids (<https://www.soilgrids.org>), a project of ISRIC-World Soil Information (ISRIC 2016). The project combines worldwide and national data from different organizations and displays them in an interactive map. The maps are spatial predictions of soil types and properties based on machine learning and global statistical models. Data for some of the maps below were obtained from SoilGrids.

The Harmonized World Soil Database (HWSD) (FAO et al. 2012) is another source for soil information. The HWSD is the result of a collaboration between the FAO and other organizations. This raster database contains data of selected soil characteristics (e.g. organic carbon, pH, water storage capacity, soil depth, cation exchange capacity) from over 15,000 soil mapping units. The HWSD is available for download, along with an application to view the data, from the FAO website.

Soil data and maps based on other soil classifications are also available for MSEA. Several countries have used, and still use, the USDA Soil Taxonomy for their soil surveys. The USDA Soil Taxonomy classifies soils according to several parameters (most commonly their properties)

and in several levels: Order, Suborder, Great Group, Subgroup, Family, and Series. USDA and WRB are comparable to some extent, and soil maps and data using the USDA Soil Taxonomy (and other less common, sometimes only descriptive soil classifications) are available at the national level. Even though some of these data have a higher resolution and provide more detailed information, summarizing and comparing these data within MSEA is challenging, because different classifications are used and the raw data is difficult to obtain.

Distribution of Dominant Soils in Mainland Southeast Asia

The following map of dominant soils (Map 2) and the calculations of the area (Table 1) are based on the Digital Soil Map of the World by the FAO (2007). The Digital Soil Map uses the World Reference Base (FAO 2014) to classify soils, and differentiates areas by different soil units. Each soil unit is comprised of a dominant soil (which covers the largest area) and one or more associated soils; e.g. a certain soil unit in Northern Thailand is comprised of 80% Acrisols (dominant soil), 10% Cambisols, and 10% Lithosols (both associated soils). Map 2 shows only the dominant soils in each area. The characteristics of the main soils in MSEA are described at the end of the article starting on Page 7..

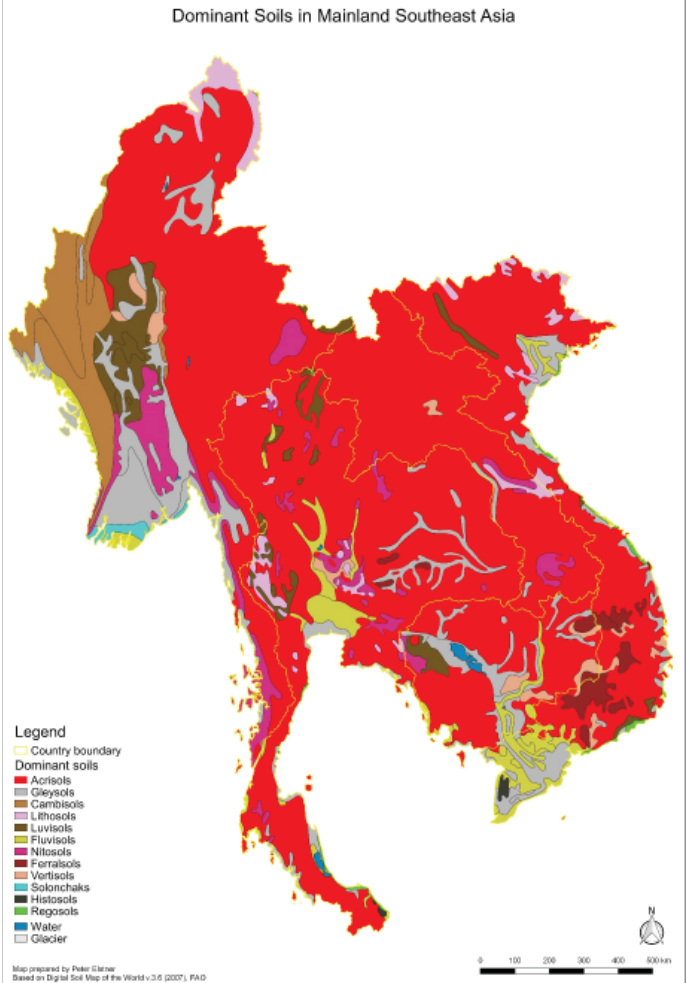
Table 1 shows the area and the percentage of each of the Reference Soil Groups (RSGs) in the five countries and in the whole MSEA. There are 18 different RSGs in MSEA, but not all RSGs are present in all countries. The calculation of the area for each RSG includes the proportional area of this RSG, both as dominant and as associated soils, in all soil units.

The results in Table 1 show that 970,247 km² (or 50.4% of MSEA) of soils are classified as **Acrisols**. Acrisols can be found in most parts of MSEA, especially in Laos, which has over 70% Acrisols. This type of soil is rare only in the river valleys, lowland plains, and along the large rivers.

Gleysols cover 190,261 km², or 9.9% of the area in MSEA. They are dominant in the inundation areas of the Tonle Sap (Great Lake) in Cambodia. They are also common in the wide valleys of rivers, in their deltas, and along the coastline in Vietnam.

Cambisols (covering 185,086 km², or 9.6%) are only dominant in western Myanmar. In other parts of MSEA, they are widespread as an associated soil with a distribution of 10-20%.

Only a few small areas are dominated by **Lithosols**, which cover 138,208 km², or 7.2% of MSEA. However, they are part of many soil units as an associated soil, with a share of 10%.



Map 2: Dominant Soils in MSEA from the Digital Soil Map of the World (FAO 2007).

Table 1: Area of Reference Soil Groups in the countries of MSEA.

Cambodia			Lao PDR		Myanmar		Thailand		Vietnam		Mainland SEA	
RSGs	km ²	%	km ²	%	km ²	%	km ²	%	km ²	%	km ²	%
Acrisols	87,929	48.2	162,924	70.7	279,145	41.9	279,081	54.2	161,167	48.9	970,247	50.4
Gleysols	35,447	19.4	4,065	1.8	62,939	9.4	45,051	8.8	42,760	13	190,261	9.9
Cambisols	10,437	5.7	23,344	10.1	66,434	10	59,454	11.6	25,416	7.7	185,086	9.6
Lithosols	6,773	3.7	21,674	9.4	55,726	8.4	28,126	5.5	25,909	7.9	138,208	7.2
Luvisols	10,951	6	3,855	1.7	44,487	6.7	34,831	6.8	7,648	2.3	101,772	5.3
Fluvisols	10,323	5.7	282	0.1	35,583	5.3	19,543	3.8	24,715	7.5	90,447	4.7
Nitisols	1,617	0.9	10,376	4.5	42,550	6.4	20,427	4	12,351	3.7	87,321	4.5
Ferralsols	3,276	1.8	142	0.1	18,874	2.8	2,320	0.5	15,630	4.7	40,242	2.1
Vertisols	5,846	3.2	1,797	0.8	17,305	2.6	6,658	1.3	5,115	1.6	36,721	1.9
Planosols	3	0	8	0	19,785	3	3,625	0.7	203	0.1	23,624	1.2
Arenosols	2,560	1.4	51	0	-	-	7,585	1.5	4,010	1.2	14,206	0.7
Solonchaks	400	0.2	-	-	10,680	1.6	6	0	920	0.3	12,005	0.6
Rankers	-	-	-	-	8,823	1.3	-	-	-	-	8,823	0.5
Solonetz	3,467	1.9	1,075	0.5	-	-	3,547	0.7	341	0.1	8,429	0.4
Histosols	-	-	-	-	3,409	0.5	393	0.1	1,331	0.4	5,133	0.3
Regosols	200	0.1	-	-	748	0.1	573	0.1	1,747	0.5	3,268	0.2
Rendzinas	265	0.1	945	0.4	-	-	2,000	0.4	-	-	3,209	0.2
Podzols	-	-	-	-	-	-	190	0	429	0.1	619	0
Water	2,944	1.6	-	-	411	0.1	1,292	0.3	-	-	4,647	0.2
Total	182,437	100	230,538	100	666,899	100	514,702	100	329,692	100	1,924,268	100

Reference: Calculated based on Digital Soil Map of the World (FAO 2007).

Luvisols cover 101,772 km², or 5.3% of MSEA. They occur mainly in the plain areas and in the plateaus in NE Thailand and Cambodia.

Fluvisols, covering 90,447 km², or 4.7% of MSEA, can be found along the large rivers and in the deltas (Irrawaddy and Mekong), mostly alongside Gleysols.

Nitisols cover 87,321 km², or 4.5% of MSEA. They mainly occur in the mountainous areas of Myanmar, Lao PDR, and Thailand, often in the same locations as Acrisols.

Map 2 displays the location and coverage of the 7 main RSGs in MSEA.

All other dominant RSGs each occupy an area of less than 50,000 km².

Characteristics of the Main Reference Soil Groups in Mainland Southeast Asia

Specific soil characteristics, which contribute to soil health and crop plant production, are used to describe and compare the main soil types.

Fertility is a measure of soil's contribution to the agricultural or ecological productivity of a given site. It incorporates information about many aspects of soil, including physical (e.g. texture, structure), biological (fauna), and chemical (e.g. nutrient availability, CEC, pH, organic matter) (Chesworth 2008).

Soil Structure is determined by the shape and size of the soil aggregates and their arrangement. A stable soil structure reduces erosion; improves infiltration and water storage; and eases root penetration (Foth 1990).

Water holding capacity is the “ability of a soil to contain and to retain water.” It depends on many factors, including “texture, organic matter, porosity, and interconnectedness of pores” (Chesworth 2008).

Drainage refers to how well water infiltrates and moves downward through the soil (percolation). It is determined by the texture and structure of soil, by characteristics of lower soil horizons, and by the ground water table.

Soil fauna include a large number of species, ranging from microorganisms to mammals. Soil fauna has an important role in decomposition of organic matter, it also influences soil formation and soil structure. Most soil fauna are beneficial, but some are harmful to plants (Chesworth 2008).

The chemical properties **pH** and **CEC** are discussed below.

A comparison of important soil characteristics of the main RSGs is shown in Table 2.

As Table 2 indicates, physical and chemical characteristics are the baseline used to differentiate soils. None of the RSGs shares a soil characteristic profile with another. Well-distinguished soil types have developed over time in very different topographic, climatic, and geologic conditions.

However, two meta-classes with certain similarities can be differentiated:

1) **Soils with low fertility.** Acrisols, Nitisols, and Lithosols tend to have low fertility because of their low pH, CEC, or shallowness (Lithosols). Since Acrisols cover the largest area of MSEA, soil fertility is low in many parts of MSEA.

2) **Fertile soils** with good chemical and physical characteristics. Gleysols, Cambisols, Luvisols, and Fluvisols are all relatively fertile. However, some of these RSGs are of limited use for agriculture due to other factors; for example, Gleysols and Fluvisols have poor water drainage.

These two meta-classes are also confirmed when looking at the chemical characteristics pH, Cation Exchange Capacity (CEC), Organic Carbon, and Base Saturation (each described below), calculated from data of the Harmonized World Soil Database and summarized in Table 3 (FAO et al. 2012). The definition of these characteristics, their importance, and the thresholds of suitability for agriculture are based mainly on the documentation of the Harmonized World Soil Database (FAO et al. 2012).

pH, measured in a soil-water solution, is a measure of the acidity or alkalinity of soil. The pH of soil greatly impacts plant growth. Five major ranges of pH are important for plant production. Soils with:

- pH < 4.5 are extremely acid soils, such as Acid Sulfate Soils (mangrove soils). They are not suitable for crops.
- pH 4.5 – 5.5 are very acid soils and often suffer from aluminum toxicity. Some acid tolerant crops, including tea and pineapple, can be grown.

Table 3: Average chemical characteristics in the topsoil of the main RSGs.

RSGs	Samples	pH (H ₂ O)	CEC	Organic Carbon	Base Saturation
	N		cmol kg ⁻¹	%	%
Acrisols	1,456	5.0	7.6	1.3	37.6
Gleysols	2,540	5.8	21.0	2.2	69.9
Cambisols	4,595	6.1	15.4	1.2	71.4
Lithosols	6,441	6.3	14.4	1.5	75.5
Luvisols	3,550	6.5	13.0	0.7	86.5
Fluvisols	1,459	6.5	15.7	1.3	78.7
Nitisols	482	5.5	14.8	1.7	53.0

Reference: Calculated based on Harmonized World Soil Database (FAO et al. 2012).

Table 2: Comparison of characteristics of main RSGs, showing typical soil health and ability to produce crop plants.

RSGs	Fertility	pH	CEC	Soil Structure	Water Holding	Drainage	Fauna Activity
Acrisols	low	acid	low	low stability	low	slow	low
Gleysols	good	weakly acid to neutral	high	NA	NA	saturation with water	low
Cambisols	good	weakly acid to neutral	medium	stable	good	well-drained	high
Lithosols	low	weakly acid to neutral	medium	stable	low	well-drained	low
Luvisols	good	weakly acid to neutral	medium	stable	good	well-drained	NA
Fluvisols	good	neutral	medium	stable	NA	stagnating groundwater	NA
Nitisols	low	acid	low	stable	good	well-drained	high

Reference: Calculated based on Digital Soil Map of the World (FAO 2007).

- pH 5.5 – 7.2 are considered acid to neutral soils. They have the best conditions for nutrient availability and are suitable for most crops.
- pH 7.2 – 8.5 are carbonate-rich soils, with limited usefulness for crop production.
- pH > 8.5 are alkaline soils, which are often highly sodic (i.e. sodium reaches toxic levels) and poorly structured (columnar structure).

Cation Exchange Capacity (CEC) specifies the total nutrient-holding capacity of a soil. A low CEC indicates low resilience and low ability to store nutrients. The amount and type of clay and the organic matter content determine the total nutrient storage capacity of a soil. Sandy soils generally

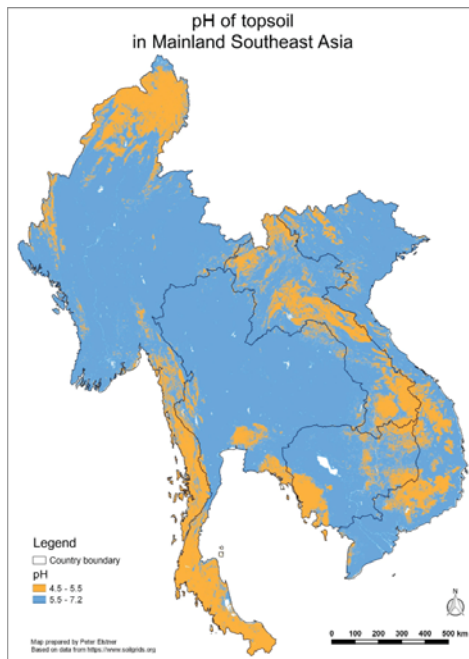
have CEC less than 4 cmol kg⁻¹. Soils with a CEC of more than 10 cmol kg⁻¹ are considered satisfactory for most crops.

Organic Carbon, combined with pH, is the best simple indicator of soil health. Moderate to high amounts of organic carbon are associated with fertile, well-structured soils. 0.6% organic matter is considered low for soils. Soils that are very low in organic carbon (<0.2%) will need application of organic or inorganic fertilizer in order to be productive.

“The **Base Saturation** measures the sum of exchangeable cations/nutrients (Na, Ca, Mg, and K) as a percentage of the overall exchange capacity of the soil (including the same cations plus H and Al). The value often shows a near-linear correlation with pH” (FAO et al. 2012). Soils with a base saturation:

- < 20% are considered de-saturated soils with similar limitations as extremely acid pH soils.
- from 20 – 50% indicate acid conditions.
- from 50 – 80% are neutral to slightly alkaline, and have ideal conditions for most crops.
- >80% indicate calcareous, sodic, or saline soils.

Table 3 shows average chemical characteristics for the main RSGs of MSEA, based on worldwide data from the Harmonized World Soil Database (FAO et al. 2012).



Map 3: pH of the topsoil in MSEA. Based on Soil Grids (ISRIC 2016).

As the numbers in Table 3 indicate, Acrisols and Nitisols are very acid soils. Because Acrisols make up half of the soil in MSEA, very acid soils predominate. Based purely on pH, all the other soils besides Acrisols and Nitisols are acid or neutral soils and suitable for agriculture.

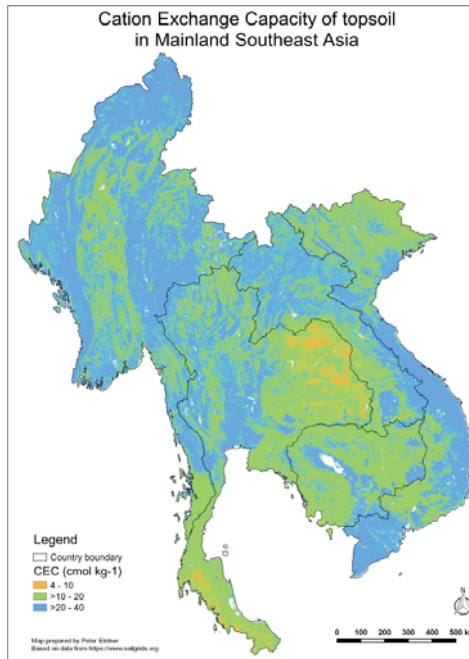
In Table 3, the average CEC for Acrisols is below the “satisfactory” threshold, at 7.6 cmol kg^{-1} , which suggests that large areas of MSEA have a low CEC. The other soils have a CEC suitable for crops. Whether this capacity for holding nutrients is actually met will depend on many other factors, including nutrient availability and pH.

On average, all soils of the MSEA region have organic carbon above 0.6% (although Luvisols are just above this threshold).

The correlation between base saturation and pH can clearly be seen by the data in Table 3. The two most acidic soils, Acrisols and Nitisols, have the lowest base saturation. The other soils have a base saturation in a favorable range for agriculture.

Map 3, 4, and 5 show pH, CEC, and Organic Carbon in MSEA based on data from SoilGrids (ISRIC 2016).

Taking into consideration that Acrisols cover 50% of the area, one would expect large areas with low pH and CEC. However, Maps 3 and 4 give a different impression and generally show higher values. Very acid soils are only prevalent in the very north



Map 4: Cation Exchange Capacity of the topsoil in MSEA. Based on Soil Grids (ISRIC 2016).

and very south of Myanmar, in southern Thailand, and in the mountain ranges in Laos (Map 3). Soils with a CEC below the 10 cmol kg^{-1} threshold are only found in northeastern and southern Thailand (Map 4). However, all areas with pH below 5.5 and CEC values from 4 to 10 cmol kg^{-1} are in areas where Acrisols are dominant. Map 5 indicates that soils in some areas, mainly in Myanmar, are low in organic matter.

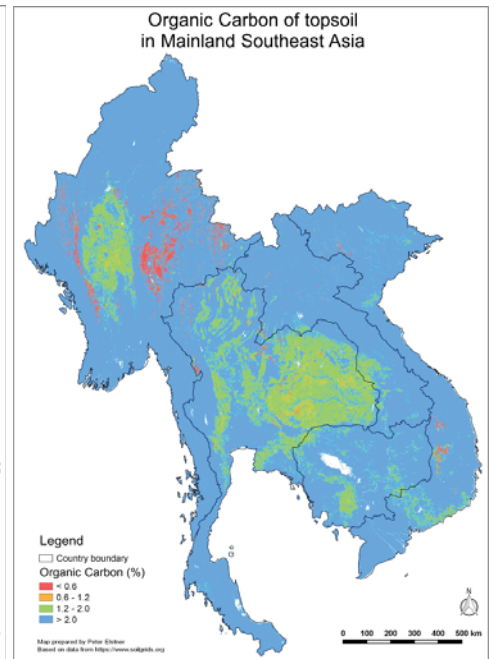
Since data from Soilgrids are predicted, and the values show an average of the properties of dominant and associated soils in an area, the accuracy is limited.

Soil Horizons

In addition to overall physical and chemical soil characteristics, RSGs are distinguished by properties of the horizon within the soil profile. A soil profile is a vertical cross-section through the soil (shown by figure 1). A horizon is the layer parallel to the ground surface. Each horizon differs from the horizon above or below based on physical, chemical or biological properties (Chesworth 2008). Seven major horizons, also known as Master Horizons, are differentiated:

H-horizon is an organic horizon with organic material on the surface that is saturated with water for prolonged periods.

O-horizon is also an organic horizon, but is saturated with water for only short periods and has 35 percent or more organic matter.



Map 5: Organic Carbon of the topsoil in MSEA. Based on Soil Grids (ISRIC 2016).

A-horizon is a mineral horizon at the surface that is a mixture of minerals and well-decomposed organic matter.

E-horizon (eluvial horizon) is a subsurface mineral horizon with a high concentration of sand and silt, due to the leaching of silicate clay, iron or aluminum to lower horizons.

B-horizon is a subsurface, mineral horizon of weathered parent material, characterized by a deposition of silicate clay, iron, aluminum, or humus (illuvial horizon).

C-horizon is the unconsolidated material (‘parent material’) from which the soil has formed.

R-horizon is bedrock, such as granite, basalt, limestone or sandstone.

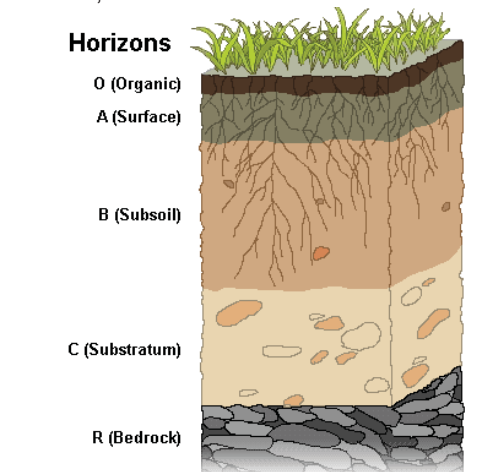


Figure 1: Soil horizons by Wilsonbiggs [CC BY-SA 4.0 (<http://creativecommons.org/licenses/by-sa/4.0/>)], via Wikimedia Commons

Description of Main Reference Soil Groups

Following is a detailed description of the characteristics of the seven main Reference Soil Groups (RSGs) in the MSEA area (Map 2). The soil descriptions, characteristics, and uses are based on "Lecture Notes on the Major Soils of the World" (FAO 2001), the "World Reference Base for Soil Resources" (FAO 2014), and the "Encyclopedia of Soil Science" (Chesworth 2008).

Acrisols

USDA Soil Taxonomy: oxic subgroups of Alfisols and Ultisols; SE-Asia: Red-Yellow Podzols

Acrisols (from L. *acris*, very acid) are strongly weathered acid soils with an accumulation of low activity clay (LAC) in the B horizon (Figure 2). They have a low base saturation.

Acrisols occur mostly on old erosional or depositional surfaces, in regions with humid, monsoonal, subtropical, or warm temperate climates.

The profile development is typically AEBtC (referring to soil horizons). Most Acrisols have a shallow, dark A-horizon with acid organic matter. The underlying E-horizon is normally yellowish and overlies a deeper yellow to red Bt-horizon (B-horizon with clay accumulation).

Characteristics:

- Low structural stability - weak micro-structure and massive macrostructure



Figure 2: Deep yellow Acrisol derived from granite in hilly terrain, China. Source: <http://www.isric.org/about-soils/world-soil-distribution/acrisols>

- Low cation-exchange capacity (CEC), low base saturation, low nutrient availability; therefore, low fertility
- pH: <4.5 in the surface horizon, 4.5 to 5.5 in B horizon
- Phosphor sorption and aluminium toxicity

Management and Use:

- Successful farming requires prevention of erosion to preserve the surface soil and organic matter
- Widely-used shifting cultivation with short occupation periods and a very long regeneration period is a well-adapted form of land use
- Agroforestry is recommended as a soil-preserving alternative to shifting cultivation
- Adapted cropping systems with liming, fertilization, and careful management are required for sedentary farming
- Acid-tolerant plants, such as rubber, oil palm, and pineapple, can be successfully grown

Gleysols

USDA Soil Taxonomy: 'aqu-' suborders of entisols, inceptisols, and mollisols

Gleysols (from R. *gley*, mucky mass) are wetland soils. In their natural state, they are continuously water-saturated for long periods of time. The predominantly grayish hues in the profile below the water table result from the reduction of iron and manganese oxides.

Gleysols are particularly abundant in the low-lying river basins and coastal swamps of Southeast Asia.

The profiles of Gleysols are mainly A(Bg)Cr or H(Bg)Cr sequences. The dark grey Ah-horizon changes into a grey or olive Bg-horizon (strongly gleyed, grey colored horizon with anaerobic conditions due to waterlogging). The Cr-horizon (weathered or soft bedrock) is grey, olive or blue and anaerobic (Figure 3). Where Gleysols remain waterlogged throughout the year, the topsoil (H-horizon) is a mixture of organic and mineral matter (muck).

Characteristics:

- Prolonged saturation with water, resulting in lack of aeration and poor conditions for soil fauna and roots
- Repeated wetting and drying may cause soil densification; the soil struc-



Figure 3: Gleysol with a fluctuating groundwater regime, Germany. Source: <http://www.isric.org/about-soils/world-soil-distribution/gleysols>

ture may deteriorate if the soil is tilled when too wet

- Comparatively fertile in depressions or at the lower ends of slopes, due to their fine soil texture and slow rate of organic matter decomposition
- Compared to other adjacent upland soils, Gleysols have more organic matter, greater cation exchange capacity, higher base saturation, and higher levels of phosphorus and potassium

Management and Use:

- Adequately drained Gleysols can be used for arable cropping, dairy farming, and horticulture
- Liming creates a better habitat for micro- and meso-organisms, and increases the decomposition of soil organic matter and the supply of plant nutrients
- Gleysols are well-suited for wetland rice cultivation
- Tree crops can be planted after the water table has been lowered, or when planted on ridges

Cambisols

USDA Soil Taxonomy: Inceptisols

Cambisols (from L. *cambiare*, to change) are soils at an early stage in their formation. Cambisols generally have a brownish B-horizon showing evidence of transformation relative to underlying horizons.

Cambisols occur in level to mountainous terrain in all climates and under a wide range of vegetation types.

The typical Cambisol profile has an ABC horizon sequence with an A-horizon over a yellowish- or reddish-brown B-horizon and a relatively unaltered C-horizon (Figure 4).

Characteristics:

- Medium-textured (loamy to clayey), with good structural stability
- Highest clay content in the A-horizon
- High porosity, good water holding capacity, and good internal drainage
- Neutral to weakly acid soil reaction
- Satisfactory chemical fertility and an active soil fauna



Figure 4: Reddish brown silt loam derived from slope wash material, China. Source: <http://www.isric.org/about-soils/world-soil-distribution/cambisols>

Management and Use:

- Good agricultural land
- Used intensively for production of food and oil crops on irrigated alluvial plains
- In hilly terrain, used for a variety of annual and perennial crops or as grazing land
- Typically poor in nutrients, but with better fertility and higher CEC than associated Acrisols or Ferralsols in the humid tropics



Figure 5: Leptosol over hard Cretaceous limestone, Italy. Source: <http://www.isric.org/about-soils/world-soil-distribution/leptosols>

Lithosols (Leptosols)

USDA Soil Taxonomy: Lithic subgroups of Entisols

Lithosols are included in the RSG Leptosols. Lithosols include very shallow soils over continuous rock and soils that are extremely gravelly and/or stony (Fig.4). Lithosols can be found in mountainous regions, on hard rocks or erodible slopes.

Lithisols typically show A(B)R or A(B)C profiles with a thin A-horizon.

Characteristics:

- Mostly free-draining, low water holding capacity
- Better physical and chemical properties on calcareous parent materials compared to non-calcareous parent materials

Management and Use:

- Not suitable for arable farming; can be used for grazing during the wet season and for forestry
- Some areas in Southeast Asia are planted with teak and mahogany

Luvisols

USDA Soil Taxonomy: Alfisols

Luvisols (from L. *luere*, to wash) are soils in which high activity clay is washed down from the surface to a lower accumulation horizon.

Luvisols are most common in flat or gently sloping land, in regions with distinct dry and wet seasons. In subtropical and tropical regions, Luvisols occur mainly on young land surfaces.

The profile is typically ABtC. The brown to dark brown A-horizon lays over a commonly (greyish) brown to strong brown or red Bt horizon. There is a marked textural difference between the horizons due to different clay content (Figure 6).

Characteristics:

- Favorable physical properties, granular or crumb surface soils, porous and well aerated
- Good drainage characteristics
- Water storage capacity is highest in B-horizon
- Surface soils may be sensitive to erosion
- Surface soils are normally wholly or partly de-calcified and slightly acid; subsurface soils have neutral reaction

Management and Use:

- These soils are generally at an intermediate stage of weathering and have high base saturation, making them highly fertile
- Suitable for many agricultural uses
- Luvisols on steep slopes require erosion control measures



Figure 6: Luvisol used for paddy rice cultivation, China. Source: <http://www.isric.org/about-soils/world-soil-distribution/luvisols>

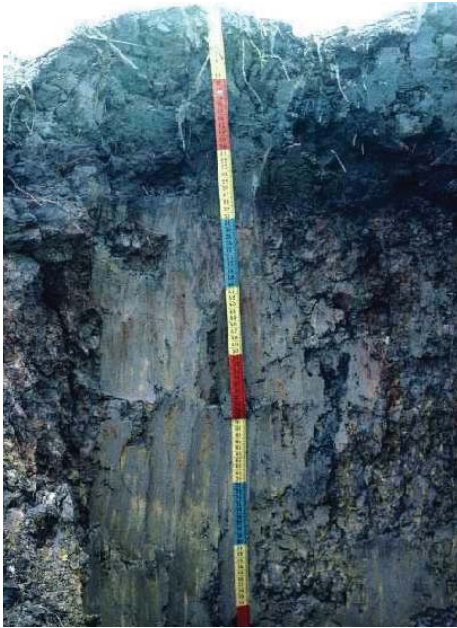


Figure 7: Acid sulphate soil of the Bangkok Plain, Thailand. Source: <http://www.isric.org/about-soils/world-soil-distribution/fluvisols>

Fluvisols

USDA Soil Taxonomy: Fluvents

Fluvisols (from L. *fluvius* meaning 'river') include genetically young, azonal soils on water borne sediments from rivers, lakes, or sea.

Fluvisols can be found in periodically flooded areas of alluvial plains, delta areas (e.g. Mekong, Red River, Chao Phraya), valleys, and (tidal) marshes. Fluvisols with a thionic horizon (Acid Sulphate Soils) are found in the coastal lowlands of Southeast Asia (Vietnam and Thailand).

Fluvisols have a weak horizon differentiation (commonly AC-profiles) and are brown (aerated soils) and/or grey (waterlogged soils) in color (Figure 7).

Characteristics:

- recent sedimentation and wetness determine the characteristics of Fluvisols
- Texture ranges from coarse sand to heavy clays
- Partly or completely wet soil, due to stagnating groundwater and/or flood water
- Terraces and river levees are better drained than soils in low landscape positions
- Neutral pH reaction
- Generally fertile (depending on the deposited material)

Management and Use:

- Suitable for annual crops, paddy rice, and orchards, or for grazing
- Flood control, drainage and/or irrigation are necessary
- Strongly saline tidal lands are best kept under mangroves

Nitisols (cf. Nitosols)

USDA Soil Taxonomy: kandic groups of Alfisols and Ultisols

Nitisols (from L. *nitidus* meaning shiny) are strongly weathered, deep, red, well-drained tropical soils. Nitisols have a clayey subsurface horizon with blocky structural elements that crumble into polyhedral ('nutty') peds with shiny faces.

Nitisols can be found in level to hilly land under tropical rain forest or savannah vegetation.

The profile has mostly an AB(t)C horizon sequence, is red or reddish brown, and is deeper than 150cm (Figure 8).

Characteristics:

- One of the most fertile soils in the humid tropics
- Stable, well-drained soils with good soil structure, good porosity, fair water holding capacity, and very good rootability
- Quite resistant to erosion



Figure 8: Deep reddish Nitisol with moderately developed blocky structure, shown left of the scale; Nicaragua. Source: <http://www.isric.org/about-soils/world-soil-distribution/nitisols>

- Cation exchange capacity (CEC) higher than other tropical soils (Ferralsols, Lixisols, and Acrisols), because of high clay content and soil organic matter
- Soil pH between 5.0 and 6.5
- Low level of 'available' phosphorus, so application of P-fertilizer is needed

Management and Use:

- Typically used for plantation crops (including cocoa, coffee, rubber, and pineapple) and for food crop production

Conclusion

The world has moved a long way from the early paper soil maps to the interactive maps and resources provided by SoilGrids, the Harmonized World Soil Database, and the Digital Soil Map of the World. Soil is essential for all terrestrial life, and it is essential to know the fertility and capacities of your soil in order to manage it wisely. It is hoped that this reference guide can serve your agricultural and community development projects by providing a background of the most common soil types in the Mainland Southeast Asia region and beyond.

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Permaculture In Development:

An introduction to permaculture and its application in agriculture development

By Brad Ward

[Editor's Note: Brad Ward, a member of the ECHO Florida team, wrote a great article on *Permaculture in Development* for a recent edition of *ECHO Development Notes*. We receive many inquiries about permaculture and how it may be used in agriculture development, so have decided to re-print it here as a potential interesting and valuable option for your work. We look forward to your feedback.]

Introduction

The word *permaculture* is mentioned with increasing frequency in speeches, books and magazine articles on sustainability and food security. What is permaculture? Is it a movement? A philosophy? Simply a set of design tools? In this article, I answer the above questions by looking at permaculture from a variety of angles. First, I briefly describe permaculture's history, underlying ethics, and key principles and common practices. Then I discuss common criticisms of permaculture and explain the underlying perspective that shapes its use in addressing a community's food, water and shelter needs (i.e., the lens through which a permaculturalist views development). Finally, I share how permaculture has influenced my own life and work, both as a Christian and as an agriculture development worker.

Definitions

The word permaculture, coined by its co-founder Bill Mollison, is formed from the words "permanent" and "agriculture." The concept of permaculture is difficult to explain in just a few words, because the term is used to describe (usually simultaneously) both a worldview/philosophy for living on the earth and a set of design principles and practices.

Bill Mollison emphasized the philosophical aspect in his definition: "Permaculture is a philosophy of working with, rather than against nature; of protracted and thoughtful observation rather than protracted and thoughtless labor; and of looking at plants and animals in all their functions, rather



Figure 1: The permaculture-designed community garden space at ECHO. Source: Betsy Langford.

than treating any area as a single-product system" (Mollison 1988).

Rafter Ferguson, a well-regarded permaculture researcher and practitioner, has an elegantly simple way to frame the many aspects of permaculture: "Permaculture is meeting human needs while increasing ecosystem health" (Ferguson 2012). To guard against reductionism, Rafter adds a cautionary statement to his concise definition, saying, "I'm all for shorthand definitions in the right context as long as it's being used to communicate a principle rather than obscure fundamental complexity" (Ferguson 2013b).

My own definition of permaculture is as follows: *Permaculture is a cohesive set of ethics, principles and practices that help guide the stewardship of an ecosystem to ensure resilience and abundance to all its inhabitants.*

Permaculturalists and Permaculture Designers

The permaculture movement is very open-source and non-centralized. A person wanting to call him/herself a Permaculturalist or Permaculture Designer is expected

to complete a Permaculture Design Course (PDC) led by a teacher or group of teachers with sufficient training and experience to teach the course. Courses are offered through universities, at small farms that have been designed around permaculture principles, and even in the backyards of urban/peri-urban permaculturalists. Each course includes 72 hours of instruction based on the main themes laid out in *Permaculture: A Designers' Manual* by Bill Mollison (1988). Courses can be structured many ways: intensive courses take place over nine consecutive days, weekend courses take place over several consecutive weekends, and online courses are typically nine weeks long.

Many people practice permaculture without calling themselves permaculture designers and without having taken a PDC. For example, ECHO's Global Farm in Fort Myers, Florida, is an excellent example of applied permaculture practice, even though it has not been specifically designed according to permaculture principles. Many ECHO Technical Notes and articles have detailed the application of permaculture principles without using the "permaculture" label.

Key Figures and Primary Source Literature

Bill Mollison (born in 1928) is considered to be the father of permaculture. In 1978, Mollison collaborated with David Holmgren to write a foundational book called *Permaculture One*. Mollison also wrote *Permaculture: A Designers' Manual*, published in 1988. This 400-page book lays down the foundational philosophies, principles and practices of permaculture. Mollison founded The Permaculture Institute in Tasmania, and created a training system to train others under the umbrella of permaculture.

David Holmgren (born in 1955) is a co-originator of the permaculture concept with Mollison. Holmgren is an Australian permaculture designer, ecological educator and writer. His 2002 book, *Permaculture: Principles and Pathways Beyond Sustainability*, provides what many view as a more accessible guide to the principles of permaculture. Holmgren refined those principles over more than 25 years of practice.

Two other authors whose ideas are featured prominently in permaculture concepts are P.A. Yeomans (1904-1984) and Masanobu Fukuoka (1913-2008).

P.A. Yeomans was an Australian inventor known for the Keyline system, used to develop land and increase its fertility. Yeomans' Keyline concepts are now part of the curriculum of many sustainable agriculture courses in colleges and universities across the world. Yeomans wrote four books: *The Keyline Plan*; *The Challenge of Landscape*; *Water for Every Farm*; and *The City Forest*.

Masanobu Fukuoka was a Japanese farmer and philosopher. He promoted no-till, no-herbicide grain cultivation farming methods, and created a particular method of farming, commonly referred to as "Natural Farming" or "Do-nothing Farming". Fukuoka authored several Japanese books, scientific papers and other publications, most notably *The One-Straw Revolution*.

Due to the recent growth in permaculture's popularity, many books have been written to help explain basic concepts or to drill deeper into a particular system and/or practice. An extensive list of permaculture books and websites can be found at the end of the article.

Permaculture as a movement

Permaculture practitioners and teachers think deeply about natural systems, and especially about human interaction with those systems. Because technology has increased the capacity for humans to make large-scale and rapid changes to entire ecosystems, permaculture practitioners often find themselves on the front lines of a debate that pits extractive greed against the long-term health of the planet. In this way, permaculture joins the larger movement of those who wish to conserve natural systems and mitigate/restore the damage done by decades of unbridled exploitation. Permaculture's voice in this movement is valuable because it offers positive, actionable design alternatives to the status quo.

Permaculture as a process for designing human community and natural ecosystems

Using a permaculture framework, the design process moves through several levels. It begins with ethics, then moves to principles, next to design strategies, and finally to technique or application.

I. Ethics

Permaculture, whether viewed as a philosophy, a movement or a design process, rests on three ethical pillars: 1) care for the earth; 2) care for people; and 3) set limits to consumption and reproduction, and redistribute surplus (Holmgren 2002). Most people can agree with the first two ethical statements, but the concepts of population control and redistribution are loaded with controversy. For this reason, many permaculture authors and teachers have simplified/modified the third ethical principle to "fair share" or "care for the future."

II. Principles – Bill Mollison

In *Permaculture: A Designers' Manual*, Mollison (1988) condensed the core principles of permaculture design into the following five statements [in bold, with elaboration from the author]:

1. **Work with nature rather than against.** This statement may seem obvious, but we humans tend to try and "have it our way" when it comes to the agriculture systems we develop. This often creates unnecessary failure, exorbitant use of natural resources, and potentially wide-spread ecological damage. Large-scale monocropping is a classic example of working against nature.
2. **The problem is the solution.** If we are willing to look at a problem from a variety of angles, we will discover that the "problem" is actually a resource for another part of the ecosystem. A good example of this is Mollison's well-known statement, "You don't have a snail problem, you have a duck deficiency!"
3. **Make the least change for the greatest possible effect.** Thoughtful interventions aimed at leverage points in an ecosystem yield the greatest returns for the time and resources invested. An example of this principle is S.A.L.T. (Sloping Agricultural Land Technology) for hillside farming. By planting trees along a contour (the leverage point), erosion is reduced, terraces are formed, and soil fertility is maintained—and possibly even enhanced.
4. **The yield of a system is theoretically unlimited.** This principle might

also be expressed by saying that it is only our knowledge and imagination that limit the sustainably productive potential of an ecosystem. A permaculture designer works to create layers of symbiotic relationships in an ecosystem. This concept is well-displayed in agroforestry systems, in which multiple stories of species work together to protect and serve each other, increasing both the total potential yield and (often) the individual yield of each component. Function stacking, another concept that illustrates this principle, refers to choosing plants and animals in a design that perform more than one function and yield more than one product. A flock of chickens is a good example of this idea; chickens provide food, feathers, manure, tillage, weed control, insect control, etc.

5. **Everything gardens (or modifies its environment).** Every part of an ecosystem directly influences certain other parts of the system and has an overall influence on the system as a whole. In complex systems, changes bring unintended consequences. Careful observation over a long period of time reduces unintended negatives.

III. Principles – David Holmgren

In his book *Permaculture: Principles and Pathways Beyond Sustainability* (2002), Holmgren expands the number of permaculture principles to twelve [in bold, with elaboration from the author]. His approach provides a more nuanced and systematic way to begin making stewardship decisions in complex and ever-changing ecosystems.

1. **Observe and Interact.** Spend a long time observing an ecosystem before starting to build or garden in it. Doing so will enable us to build or garden as efficiently and sustainably as possible.
2. **Catch and Store Energy.** Energy of all types flows into and out of all ecosystems. Make the most of these resources, and minimize/eliminate any losses. Energy resources include: sunlight; water; seeds; inherent heat (such as in stones and water); wind; and organic matter (in soil and compost).
3. **Obtain a Yield.** When growing plants for food, fuel, textiles and/or beauty, we want to obtain a yield. Good

stewardship is about abundance and blessings we can share.

4. **Apply Self-Regulation and Respond to Open Feedback Loops.** Negative feedback can point to unsustainable methods, and probably means we need to do things a little differently. Excess positive feedback may hurt other systems. Our goal is balance. For people accustomed to viewing agriculture projects and/or development work as a series of problems to be solved, reading the negative feedback signals can seem fairly straightforward. Evaluation of excessive positive feedback can be harder to observe and discern. For example, for decades, mega-scale monocropping symbolized best-practice modern agricultural productivity. The negative environmental and human impacts of these systems were easy to miss, and remain easy to rationalize in the light of their enormous capacity to provide the raw materials for cheap calories and corporate profits. It is difficult in the dominant system to say “no thanks” to short term gains (excess positive feedback), even when we recognize that there will be a cost to both people and the planet.
5. **Use and Value Renewable Resources and Services.** Conserve non-renewable resources, and always seek to restore resources. Expand our thinking about what could be a resource.
6. **Produce No Waste.** Ideally, everything that is needed is made on site, and all byproducts become inputs for another part of the design.

7. **Design from Patterns to Details.** Sort out the big picture first; everything else falls in place after that. Big picture items include factors like climate, terrain and sun aspect. Taking these items into consideration at the very beginning is critical to all of the other decisions that follow, and they ultimately determine the pattern of the design. A permaculture designer uses strategies like sectors and zones (see descriptions below) to help determine the overall pattern. He/she then moves toward specific techniques and plants.
8. **Integrate Rather Than Segregate.** Every element in a system has strengths and weaknesses. In permaculture, we can use this to our advantage by pairing elements with complementary needs, so they help each other grow steadily. For example, in a keyhole garden, the composting system is directly integrated into the garden bed. Placing this keyhole garden close to the kitchen further integrates the system by locating the production area of fresh greens and the receptacle for trimmings and waste near the place where they are used, thus reducing labor.
9. **Use Small and Slow Solutions.** Small and slow changes build resilience and diversity, making our system adaptable and reducing the effect of negative unintended consequences.
10. **Use and Value Diversity.** Diversity forms the foundation of resilience.
11. **Use Edges and Value the Marginal.**

The borders or edges between different ecological zones and micro-climates are places of great diversity and potential. Species that can thrive on both sides of the edge have an advantage in these zones and can increase the productivity of the entire system.

12. **Creatively Use and Respond to Change.** Things will always change; that’s guaranteed. Respond to change by innovating continuously, and don’t give up.

IV. Design Strategies

Connecting the ethics and principles of permaculture to a specific site requires a framework of design. Designers use a wide variety of methods to organize their thoughts and articulate their ideas. Some common tools are as follows:

Yeoman’s Keyline scale of permanence (Fig. 2) takes into consideration both the time and energy needed to make a change to a specific site or ecosystem. At the top of the scale, at the far end of both the time and effort axes, is “climate”; this aspect would require the most time and energy to change. At the bottom of the scale is “soil.”

Sectors (Fig. 3) are used to identify the various factors that interact with a site. Sectors would include phenomena like the path of the sun as it crosses the site; direction of seasonal or predominant winds; human and animal traffic patterns; noise; and visual impacts.

Zones identify the human interaction required to maintain specific areas of a site. Typically there are 6 zones, numbered 0 – 5. Zone 0 identifies the home or business structure where people live or work. Zone 1 is the high human traffic area of the site; in a residential setting, zone 1 would be the walkway between the driveway and the front door. It would also include the patio or a nearby kitchen/herb garden. Zone 2 would likely include things like annual vegetable beds and chickens, zone 3 would include fruit trees and pasture, zone 4 would have fuel wood, and zone 5 would be left wild to allow for continued observing and learning from nature.

V. Practices/Techniques

Multi-species integration (plant guilds). Permaculture designers seek to bring multiple stories (canopy levels) of plants together in “plant guilds” to increase and diversify the yield in the system and to add resilience. Agroforestry and forest gardening are exemplary types of plant guilds. An example of a tropical plant guild would be an overstory tree such as a mango combined with shade-loving Barbados cherries, and below them, comfrey and garlic chives.

Agroforestry (multi-story, perennial-based food, fuel and fiber systems). The above example of plant guilding is also a good example of part of an agroforestry system. Agroforestry systems are designed to

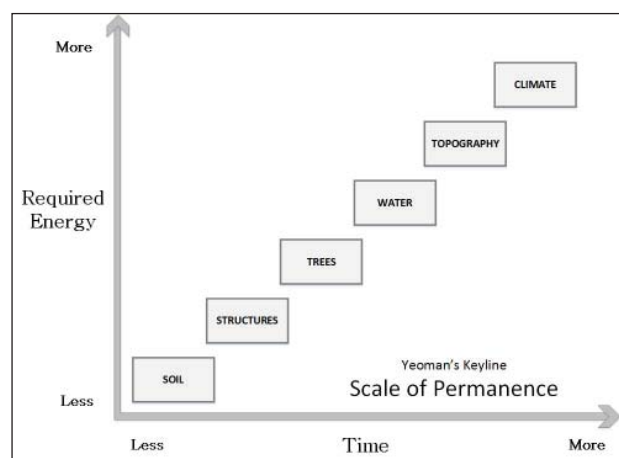


Figure 2: Yeoman’s Keyline Scale of Permanence considers the time and energy needed to make a change to a site or ecosystem. Adapted from Owen Hablutzel’s Scale of Permanence graphic.

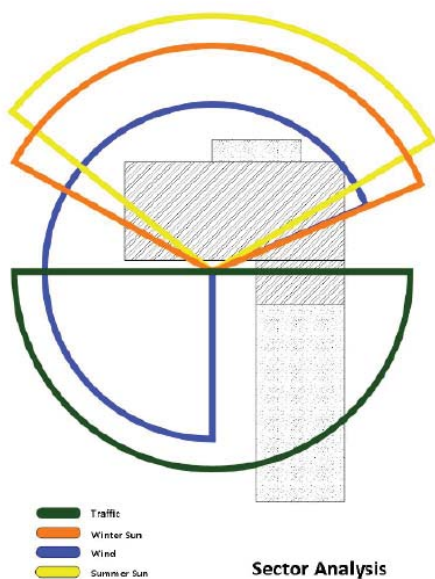


Figure 3: Sector Analysis helps identify the different elements that interact with a site.

maximize the usable yields for humans from a multi-storied forest, while maintaining the diversity and increasing the fertility of the forest itself.

Slowing and retaining water. Water is a cornerstone resource in any agriculture system. Good permaculture design keeps ideal levels of moisture in the system with minimal energy inputs. This means channeling away excess water, retaining water in dry seasons, and helping water penetrate the surface to get to the root zone of plants.

Composting. Composting ensures that fertility and nutrients stay inside and are recycled through an ecosystem. From simple compost piles to vermiculture systems to composting latrines, all sources of fertility are valuable and should be stewarded to our best ability.

Natural building. Where possible, use locally available and renewable materials to satisfy the need for shelter. This will help encourage local economies and preserve non-renewable resources. Secure and comfortable homes don't have to look like the suburbs of the West, and imported designs and materials often lead to less comfort and safety. A good example of this is a metal roof replacing palm thatch. The metal roof is often less resistant to hurricane winds; it also transmits heat from the tropical sun, making the house unbearably hot during the day.

Common Criticisms of Permaculture

One common (and sometimes accurate) criticism of permaculture is that proponents make claims about yield potentials or resilience factors with little reliable data to back them up. Because promotion and documentation of permaculture practices is largely decentralized, no official governing body exists to validate the claims of permaculture practitioners and of those who tell permaculture's stories. Lately, there has been robust discussion within the permaculture community about being more careful about what is claimed as fact, and about seeking partnership with people and institutions that can help verify good practice with good science and increase the community's capacity to carry out experimentation that produces usable data and/or leads to more extensive research.

A second, more superficial, criticism of permaculture centers around the lifestyles of people who identify with it. Those caught up in a modern westernized paradigm might be tempted to criticize and marginalize those who have a different outlook, rather than try to understand their point of view—especially if that different outlook challenges some of the practices that make one's life comfortable.

Permaculture in Development

Many permaculturalists subscribe to a post-industrial vision of the future. They see permaculture as a tool to prepare for a less mechanized, less economically globalized and de-urbanized world. As a result, they view the development process differently than typical traditional western development workers would. This view shapes permaculturalists' "better future" paradigm, which impacts their choices regarding prioritization of labor and resources.

As an extreme example, a traditional western development agency working with smallholders in a rural setting might work to create supply and distribution chains that allow the smallholders access to the global market. It might bring non-local and non-renewable resources into the area to increase yields of a single crop or small variety of annual crops. It might envision consolidating smallholder farms into one larger operation to increase efficiency, thereby creating a smaller, more efficient labor force with the hope that those displaced would find better incomes off of the farm. All these efforts would be carried out under the

guiding vision that the modernized industrial world is our best vision of the future; that increasing the economic base by creating more consumers has no resource barriers that technology can't overcome; and that hard physical work and traditional rural living are things from which people ought to be freed.

By contrast, a permaculture designer working in the same situation would seek to strengthen the independence of the rural community and protect it from outside influences. He/she would seek to first create an ecosystem and social system that meets basic human needs, and that then trades out of its abundance, with maximum biodiversity. Rather than creating consumers, good permaculture seeks to create more resilient and successful producers who stay on the land, with the knowledge that their lives are valuable and that their work is among the most intricate and dignified.

My Personal Permaculture Story

My own embrace of permaculture, as both a design tool and a paradigm through which to view good human development, started about 11 years ago. As I embarked on a new career as a "community development/agriculture missionary," and uprooted my family to a new culture and environment, I began to ask myself a very basic question: "What is development for?"

I was unsatisfied with initial answers that were based on experience. I could see the truly unsustainable nature of so much that was being called sustainable. I could see that the enhanced quality of life promised by the modern world often led to greater depths of misery and despair. I could see that when I said the word "development," I projected a vision of middle class Americana; and I could see that that very lifestyle was crushing the world's ecosystems and was by its very nature unsustainable.

I began to look for a different answer. My reading and research led me to the concept of permaculture. Permaculture provided a new way of thinking about how man could live a productive, abundant life, while nurturing and stewarding creation. I saw that, rather than just laying out a utopian vision, the Permaculture Design Manual and other permaculture literature gave step-by-step instructions for evaluating the natural systems around me and systematically bringing resilience and abundance into those systems. Permaculture design

gave me an organized way to look at the big picture, and to plan and test small incremental changes.

Permaculture is good stewardship. For me, it is also a way to work for God's kingdom. I view permaculture's ethical pillars (listed earlier in this article) through different lenses, so that they become the following: 1) actively love God's image bearers; 2) diligently steward God's creation; and 3) live contentedly and joyfully share God's provision.

After practicing permaculture principles on my own for a few years, I took a Permaculture Design Course to increase my proficiency and confidence in using the design processes. The class was challenging and extremely helpful. The exchange of perspective and experience was invaluable, as was having design concepts evaluated by fellow students and a professor. As mentioned earlier, permaculture classes are offered in a variety of formats. The resource section has some links to well-respected courses.

Conclusion

Permaculture is part of the growing community of eco-agriculture disciplines. It is rapidly gaining acceptance as a valuable design methodology in both non-government and government institutions across the globe. It is adaptable to every ecosystem and culture, and offers accessible problem-solving tools rather than silver-bullet solutions. It considers the ecosystem and social system as a whole, facilitating good stewardship, and providing a pathway to true sustainability, resilience and abundance.

Recommended Resources

Books:

- Bane, Peter. *The Permaculture Handbook: Garden Farming for Town and Country*. BC, Canada: New Society, 2012.
- Beyer, Hunter and Franklin Martin. *Permacopia Book Three: Plants for Permaculture in Hawai'i, & other Tropical & Subtropical bioregions*. Volcano, Hawai'i: Homescapes, 2000.
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Yeomans, P. A. *Water For Every Farm: Yeomans Keyline Plan*, 4th ed. CreateSpace Independent Publishing Platform, 2008.

Periodicals:

Acres USA – www.acresusa.com

Permaculture Design Magazine – www.permaculturedesignmagazine.com

Internet:

<http://permies.com>

<http://holmgren.com.au/permaculture/>

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<http://permaculturenews.org/>

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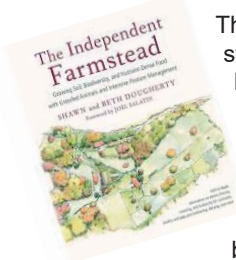
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Book Review: The Independent Farmstead

Review by Craig Soderberg



The Independent Farmstead: Growing soil, biodiversity, and nutrient-dense food with grassfed animals and intensive pasture management

by Shawn and Beth Dougherty

Published in 2016 by Chelsea Green Publishing, White River Junction, VT ISBN: 978-1-60358-622-1

This book starts by comparing extractive farming to regenerative farming. Extractive farming refers to modern industrial farming of one crop on an extremely large scale which is completely dependent on off-farm inputs. But regenerative farming has the opposite approach and opposite emphases: natural instead of mechanical, local rather than global, small rather than large, dependent on human labor and planning, and diverse. Regenerative farming usually has a diversity of animal species as well. Sheep, grazing with cows, utilize plants not favored by bovines; poultry follow both and scavenge undigested seeds and pest larvae from their manure. Pigs forage at the bottom of the food chain, converting almost any kind of surplus nutrients into pig flesh and nitrogen-rich manure.

The first step in starting a farmstead is to acquire land. When looking to buy land, don't just think of realtors. Instead, look at the local want ads, newspapers, classified magazines, craigslist, bulletin boards, regional agricultural papers. Also talk to vendors at farmers' markets, people at the local extension office, or the man at the feed store. For creative buyers, the neglected, abandoned acres may be the most promising, and neglected land is generally less expensive. Also because electric fencing equipment is so portable, it is possible to take advantage of borrowed land without putting money into someone else's property. Also ask at the Natural Resources Conservation Service (NRCS) about local water toxicities. Also, check local zoning laws before you buy. Are there restrictions on the number or type of livestock that can be kept there? What do the laws say about septic systems? Do they require installation of access to municipal water, sewage, or gas lines, whether or not the landowner intends to use them? Be

careful with existing pastures if they have been managed conventionally. In all likelihood they have been chemically fertilized and planted with just one or a few species of pasture grass.

The authors discussed the pros and cons of various water sources, such as municipal water, wells, surface water (ponds, streams, rivers, and lakes), rainwater runoff, and cisterns. The section on grass and grass management discussed different grazing strategies. I was surprised to learn that cattle that pasture all winter look healthy right up until a few weeks before greenup, when grass condition finally deteriorates. At the same time, the barn-kept animals - sheltered on deep bedding, with water just a few steps away and fair- to good-quality hay took on a 'winter look' - leaner, bonier, rougher-coated, and less blooming. There is also a record-keeping aspect of grass management. Draw your farm freehand and put down the distances in paces. Make copies; then draw, write, or record dates, paddock sizes, number, age, and species of livestock, grass condition, forage species, duration of grazing, etc. Then use this information to help you plan future grazing.

Intensive grazing is not complicated. Livestock are confined to a very small area where they must graze less selectively and more thoroughly than in the large paddock. In a short time, every square foot of the paddock will be either grazed, trampled, manured, or urinated on. Intensive grazing is made possible with light-weight portable, electric fencing.

In choosing which ruminants to raise on your land, it is good to ask what, if anything, was raised on the land in the recent past. This can be a serious issue, since commercial livestock operations today are frequently the source of considerable and lasting soil and groundwater contamination. Also, water, its source and availability, must be a consideration when you are choosing a ruminant. How much - or how little water - is presently available can tip the balance in favor of smaller species needing less space.

The chapter on chickens mentioned chicken tractors and hen housing but no plans and no measurements or diagrams were included. Also the authors said, "Some breeds can forage for nearly all of the food." But the authors did not mention

which breeds could forage for all their food. But thankfully the authors did provide a sample poultry mix that farmers could make on their own, a combination of sunflower seeds, millet, wheat, oats, and barley, in a 2:1:2:4:3 ratio. The farmer can grow these plants himself and then make the poultry mix.

The pig chapter mentioned that the grass-hay-and-dairy-fed hogs at Sugar Mountain Farm in Vermont spend their whole lives on pig pasture, without commercial or grain supplement. This is encouraging to know that pigs can be raised without need for outside feed inputs. It was also good to read the story of how the authors 'saved' some newly-arrived-pigs who had "shipping fever" with just colostrum and raw milk (p.229).

This book will help the reader consider some of the factors related to acquiring land and getting started in setting up a farmstead. The authors rightly state that setting up a farmstead will help one get more closely connected to their community and to be able to help others in need by, for example, donating a hog to a local widow with young children.

Upcoming ECHO Asia Workshop in February 2017



Northwest Myanmar Agriculture and Community Development Workshop

February 7 – 10, 2017
In Kalay Myo of the Sagaing region of Myanmar

Registration fee is USD110
(inclusive of workshop, meals and basic accommodation)

ECHO Asia, in partnership with the CSSDD of the Myanmar Baptist Convention, is pleased to offer training in NW Myanmar. Some of the 14 topics presented may include:

- Biochar and water filters
- Seed banking and seed saving
- Integrated agriculture options for sustainable land use
- Presented in both Burmese and English.

For more information or to register please contact us!
Expats: echoasia@echonet.org or register at ECHOcommunity.org
Myanmar nationals: CSSDD at Myanmar Baptist Convention, 143 Minyekyawswa Road, Lanmadaw, Yangon 11131, Republic of the Union of Myanmar tel. 01-212502, email: mbc.cssdd@gmail.com



Upcoming ECHO Asia Workshop in May 2017



Nepal

Agriculture and Community Development Workshop

May 22 - 24, 2017
Annandaban Training Facility
Kathmandu, Nepal

ECHO Asia, in partnership with the Medical Teams International and Shanti Nepal, is pleased to offer this valuable training in May 2017! Some of the 12 topics presented may include:

- Neglected and Underutilized Species (NUS)
- Climate-Change Adapted Agriculture with a Focus on Green Manure Cover Crops
- Seed Banking and Seed Saving

Registration fee is USD75. Fee includes 2 days of training, 1 day of site visits, 2 coffee breaks, and light breakfast and lunch. Accommodations *not* included.

Presented in both Nepali and English.



For more info or to register visit:
ECHOcommunity.org

Upcoming in October 2017

6th Biennial ECHO Asia
Agriculture & Community Development Conference
Chiang Mai, Thailand



Our conference theme "Improving Lives" expresses our desire to partner with you as we train, equip, and grow our network to impact the lives and livelihoods of farmers and their families across Asia.

Speakers will share practical solutions to agricultural challenges, personal experiences, and strategies for improving the lives of millions who daily face the threat of starvation. The event offers an open exchange of information, connecting the people and ideas that can make a real and sustainable difference.

Come join us for 3-days of plenary speakers, workshops, coffee cupping, paper proceedings, a poster session, and a seed exchange followed by a 1-day site visit!

Go to AsiaConference.ECHOcommunity.org to register and to learn more about what our conference seeks to offer.

Now accepting applications for workshop, poster and paper submissions! We are pleased to announce that our next 2017 ECHO Asia "Improving Lives" Conference will provide conference delegates with an opportunity lead workshops and to submit posters and/or research papers for publication and distribution to our network. This will provide conference attendees with another way, in addition to a talk or workshop, to share and exchange information.

Workshops: If you would like to present a relevant topic, we would love for you to submit an application for an afternoon workshop presentation.

Posters: consider creating a poster for display at the conference venue. Your poster can then be viewed by other conference delegates at their leisure, as well as during designated times for poster presenters and other conference attendees to interact.

Papers: please consider submitting a paper summarizing some of the research you may have conducted in recent years. We hope that in this way, any interesting research findings from within our network may be shared in a more formal manner with practitioners throughout the region.

There will also be an opportunity, during a late-afternoon or evening session, to give a five-minute oral summary of your paper/poster. To learn more, go to our conference website below or go directly to the application page to learn specifics on how to submit your proposal.

Early Bird Conference Packages in USD/THB if registering before 31 August 2017

- Day Package (conference only, no lodging): \$150USD/ 5,250THB
- Shared Room (conference and 4 nights shared room) Package: \$200/ 7,000THB
- Single Room (conference and 4 nights single room) Package: \$250/ 8,750THB
- Spouse Package (4 nights lodging, no conference): \$60/ 2,000THB

For more information and to register email us at echoasia@echonet.org or go to:

AsiaConference.ECHOcommunity.org





Encouraging Community Participation ***A LEAD Community of Practice Event***

17-19 May 2017
Bangkok, Thailand

Do you already use a participatory approach within your organization or with the communities with which you work? Do you sometimes face challenges in encouraging community participation in activities or changes? Would you like to learn from others who are using participatory approaches and have experienced some measure of success with community participation in their activities?

If so, then this event is for you!

During the event we will grow in our participatory mindsets, share participatory techniques and tools that we have created or found helpful, and wrestle with problems or challenges we have faced in increasing stakeholder participation.



For more info or to register:
LeadImpact.org
languageimpact@sil.org



LEAD
Language, Education and Development

"LEAD CoP (Community of Practice) events are great gatherings to connect with other practitioners who are creatively thinking about community development and the ways that different issues intersect. These events are very participatory based, full of exchange and interesting conversations. I always enjoy connecting with and learning from participants connected to LEAD and would recommend these events to ECHO Asia network members highly."



Financial Literacy & Business Startup Tool for Myanmar

MICRO EMPIRE is a social business that educates Myanmar people in financial literacy and lean business startup. They also invest in micro businesses.

MICRO EMPIRE has just launched it's online education platform which sells its classes for only \$1. Each class consists of video, text, cartoons, graphs, discussion questions, and a quiz. The classes are 11 modules long and explain financial management in simple terms.

Please email our ECHO Community member Ryan Russell (ryan@myanmarbusinessanswers.com) for more information about this exciting business supporting social sustainability in Myanmar!

The collage features the Micro Empire logo at the top right. Below it is a cartoon of a man in a tank top and shorts holding a hammer, with a speech bubble saying "စတင်ဆင်နွှဲတာ မဟာမိုင်းကတည်းကရှိပြီ" (It's been there since the start of the world). To the left is a screenshot of the Micro Empire website showing various course options. Below the website is a photo of a man wearing a headset and working on a laptop, with a red 'dot' logo in the top left corner. To the right of the photo is a diagram illustrating the business model: "Training" leads to "Micro Enterprise" (represented by a house icon), which leads to "Investment" (represented by a magnifying glass icon). The diagram also includes a section for "Micro Enterprise" with a list of items and a "Micro Enterprise" section with a list of items.

SAVE THE DATE
8-9 March 2017
KIB, Dhaka, Bangladesh



Regional Symposium on Integrating Gender and Nutrition in Agricultural Extension Services jointly organized by DAE – INGENAES



Going Beyond Extension.....

Join the Symposium to Contribute, Identify Opportunities, Brainstorm, Share Experiences and Build Networks for Scaling out Nutrition Integration in Agricultural Extension in Gender Sensitive manner.

For more information and to register go to:
www.ingenaes.illinois.edu/bd-regional-symposium

Pre Event

NUTRITION
OLYMPIAD 2017

Date: 7 March 2017
Venue: Krishibid Institution, Bangladesh (KIB).

Call for Articles and Insights

We are delighted that you receive and read our ECHO Asia Notes. We hope that the information contained here within is useful to you and most importantly, useful to those whom you serve. I wanted to highlight a few things that you may find add value to your free membership to ECHOcommunity.org and can help you be more effective.

1. Please do remember that a "Development Worker" membership entitles you to 10 free trial packets of seed per year, so be sure to take advantage of this! If you would like more seed packets or larger quantities of some seeds (especially green manure/cover crops), we do have additional seed packets and bulk seeds for sale, and our [Seed Bank catalogue is available online!](#)
2. Please also know that besides being written in English, our [ECHO Asia Notes are translated and available for free download on ECHOcommunity.org](#) in Thai, Khmer, Burmese, Mandarin, Bahasa Indonesia, and Vietnamese languages.

3. Don't forget that we have a [special place in the Asia section of ECHOcommunity.org](#) for additional technical resources, free book downloads, and [presentations from past ECHO Asia events and workshops](#).
4. If you have never joined us for an event, please consider doing so- upcoming events include the [Northwest Myanmar Agriculture & Community Development Workshop](#) and the [Nepal Agriculture & Community Development Workshop](#). Other upcoming events will be posted to ECHOcommunity soon.

In addition to using our information, we strongly encourage you to provide feedback to us in order to better know how to serve you and to help us to refine our resources and delivery. In the future, we hope to have an automated feedback system, seed evaluation system, and better monitoring and evaluation so that we can better equip workers.

We encourage you to share success stories, lessons learned, insights, Facebook posts,

etc. with us to keep us abreast about what you are trying and what is working in your context.

Additionally, if you have any ideas or would like to write an article for an upcoming ECHO Asia Note, we invite you to do so! You can always contact us at echoasia@echonet.org. Thank you for reading, and please do stay in touch!

Best regards,

Abram J. Bicksler, Ph.D.
Director, ECHO Asia Impact Center

