

# Relevance of Soils for Gross National Happiness

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## Introduction

“Think how difficult life would be without soil to grow food crops.” This sentence from a Bhutanese geography schoolbook for class VII students (RGoB 1994) may sound trivial in our ears. But sometimes I believe that it is useful to remind ourselves of the very basic things in life. Each of us has seen soil (at least its surface), smelled and touched it and very physically used it for planting our food. Its presence is so obvious and yet its fertility so essential for all agricultural activities as the main source of our livelihood. The four Buddhist means to avoid dissatisfaction (food, shelter, clothing, medicine) are directly or indirectly related to it.

However, soil is not only part of our household (economy), but also integral part of nature’s household (ecology). Therefore, e. g. talking about soil means looking at environmental conservation as well as agricultural production. And where the spheres of Man and Nature meet, the domains of spirits and local deities are located. Being aware of these few aspects, it may not surprise that there are multiple points of contact between the down-to-earth subject of soil and the high-minded goal of Gross National Happiness (Table 1):

Table 1: Soils and their affinity to Gross National Happiness

GNH constituent	...and how soil is related to it
economic development	soil fertility = “natural capital” RNR sector made up 33% of the GDP in 2002 policy of self-reliance care of the soil contributes to well managed HEP and national wealth
promotion of cultural heritage	“agri-culture” (e. g. land use techniques) belief in deities ( <i>kLu</i> )
environmental preservation	integral part of ecosystem
good governance	equivalent of “good farming practice” concept of “sustainability”

Soil is indeed a good example of sunyata, of the way, how things are interrelated to each other in non-hierarchical relationships. In the following, I want to examine three “spheres” where soil is essential, and as this seminar is about conceptualising and implementing the philosophy of Gross National Happiness, make some suggestions about what can be done at various levels to maintain Bhutan’s soil resources.

### **Sphere 1: Soils as an integral part of the environment**

Soil can be seen as a dynamic, living system of organisms reacting with organic and inorganic matter. Major ecological functions include soils as:

- interface between all other parts of the ecosystem (atmosphere, hydrosphere, biosphere and lithosphere)

- warm, well watered and stable habitat for animals, plants and microbes
- recycling of dead and discarded organic material into inorganic nutrients for future life

- integral part of the global element cycles

- storage of nutrients and water from times of plenty for future shortages

- natural water filter

- chemical buffer and reprocessing, turning potentially harmful substances into useful materials for the continuation of life

A first comprehensive paper (Baillie et al. 2004) about Bhutan's soils and their distribution and properties will be published in March 2004, presenting the findings of the Bhutan Nation Soil Survey Project (MoA, Simtokha) lead by Chenchu Norbu. It is impossible to summarise the findings in a few sentences and I therefore only want to point out few aspects:

- soil formation within the Bhutanese landscape is often complex, and one soil profile may contain different parent materials, which complicates the interpretation of analytical results and the classification within international systems.

- there is altitudinal zonation of the soils

- the soils of the southern foothills are less developed than expected from the wet and warm climate; this is maybe due to the geological instability of the area close to the Main Boundary Thrust (MBT)

- up to at least 3000 m, the soils are moderately weathered and leached

- higher up, soils become increasingly acid with growing surface litter and less developed subsoils

Taking into account the adverse conditions for soil development in Bhutan (steep slopes, intensely seasonal monsoonal rainfall, increased pressure through growing population), the current condition of the soil cover is surprisingly satisfying. This fact also finds its expression in the virtual absence of past and present (reported) famines.

### **Sphere 2: Soils and land use**

Little is known about the early history of Bhutan. It seems likely that early settlers - maybe m(o)enpa people - mainly relied on forest resources for their livelihood. During our current cooperation project we discovered and dated charcoal on top of fossil A horizons (former topsoils, now buried) within Phobjikha valley, indicating some kind of slash and burn land use,

maybe in connection with “primitive agriculture” from at least 2000 years before present in full. With the arrival of Pema Lingpa (1450-1521) at the latest, the influx of people into this valley grew rapidly, and grazing and possibly also arable agriculture and deforestation was probably more intensive than before.

With time, different indigenous farming systems evolved all over Bhutan, which must have generally been successful and lead to what we nowadays call sustainable land use, e. g. tseri (shifting) cultivation, pangshing (grass fallow), crop rotation, intercropping, contour ploughing, regular application of organic matter and low plant population densities. Apart from signs of more frequent land slides in the steep eastern areas (especially in terraced rice fields around Radhi) and naturally high soil erosion in the southern belt due to higher rainfall and unstable geology, soil degradation is not common nowadays.

However, the pressure on the soil is increasing. With population growth at around 3.1% (RGoB 2000), the number of people to be fed is likely to double by 2020. Further fragmentation of land may occur, with the average agricultural land holding currently being at only 1.5 hectares per household (RGoB 2000).

Declared political aims as defined in the 9<sup>th</sup> plan include:  
 enhancing rural income,  
 achieving national food security (“self-reliance”),  
 conserving and managing natural resources, and  
 generating employment activities

The scope to reach these aims is considerably narrow, as the portion of cultivable land is unlikely to exceed 10% of the country’s total area (Baillie et al. 2004), of which already 8% are currently under use. Until today, increased agricultural production as well as productivity have been implemented mainly by enhanced fertiliser input, new and/or improved seeds, farm mechanisation, shortened fallow periods and the construction of irrigation channels.

For the short term, positive effects like increased harvests and additional incomes for farmers have been obtained. It has to be pointed out that besides new opportunities, the present development results in land use changes (e. g. shortening of fallow periods; conversion of gently sloped, fertile tseri land into permanently used dry land) and creates a range of soil-related problems, e. g.

negative chemical impacts: reduction of organic contents leads to reduced stability of soil aggregates; depletion of macro- and micronutrients (e. g. observed Zn and B deficiencies in apple and citrus orchards; Norbu, pers. comm. ); acidification due to fertiliser use; pollution through pesticides and fertilisers (e. g. over-fertilisation of maize with urea in eastern Bhutan (Baillie et al 2003);

negative physical impacts: soil compaction negatively effects the soil structure, leading to decreased water permeability, aeration and root growth;

chemical and physical degradation will result in a decrease in soil organisms and their biodiversity; besides soil life, all external organisms may be affected by intensive use of pesticides.

General dangers include the loss of soil fertility as a combination of biological, chemical and physical properties, often also termed soil/land degradation. By extrapolating observations and data from outside Bhutan, Young (1994) estimated 10% of Bhutan's arable land being subjected to some degradation. Norbu et al. (2003) provide the first reliable account of the different types of land degradation within the country with special attention to their occurrence, causes and interactions. In situ degradation due to soil organic matter depletion is identified as the main degradation process.

In autumn 2002, our research team examined the ravines below Tshogompa, a small village situated south of Wamrong (Lumang geog) along the Trashigang-Samdrup Jongkhar highway. During the course of our stay it became clear, that the local soils have developed in steep terrain and unstable geology (Shumar formation) as unfavourable "natural settings", and have been further destabilised by deforestation, poor water management (leakages from water pipe system installed in the 1980s) and failed development efforts (e. g. a trial to start rice farming on slopes lead to new landslides and was soon stopped). Thus, a mixture of natural and man-made causes is responsible for a bad case of soil degradation, the complete loss of soil through land slides and ravines.

Fast and complete loss of soil also occurs during urban growth, which often affects the most fertile areas (e. g. Thimphu expressway).

### **Sphere 3: Spiritual dimension of soils**

Having grown up in the Western world, my understanding of Buddhist philosophy and its implications for everyday life is necessarily restricted. I therefore have to apologise for the shortcomings of this section and hope that the Buddhist reader will be able to add her/his own views and ideas to this important aspect.

From my stays in Bhutan I have been impressed by the strong emotional connection which people of all age seem to have with the soil. I would guess that for nearly all of them, soil is more than a mere production factor and maybe even a medium through which to get in contact with local deities and spirits. Locations for our fieldwork had always to be carefully chosen, and had to be at a certain distance from the next religious building (dzong or lhakang) or other "holy places", which were not as visually obvious, at least not to us European visitors. While digging a profile, the topsoil with its plants was carefully removed (and put on top again afterwards) and all macroscopic animals were brought to safety. When we

wanted to dig a soil profile close to Rukubji, we would have only been allowed to do so if we could have promised not to cause a future crop failure. At that time we did not know about the local crop failure in 1984 which was seen as a consequence of annoying the protecting deity *dramar pelzang* by moving his dwelling (*tsenkhang*) to another place following road construction in 1981 (Schicklgruber & Pommaret 1997).

Karma Ura (2001) has compiled numerous examples of how deities mediate the relationship between people and local resources. Negative human influences like killing animals (in case of land use e. g. by ploughing), polluting the environment (via fertilisers and/or pesticides) or using land which is associated with deities may result in crop loss, landslides or natural disasters. The people's reverence for the soil's fertility and the hope that the next harvest will be similarly successful finds its expression in the habit of pouring some drops of each drink on the ground before drinking. Another form of appeasement offering is seen in the acceptance that parts of the crop will be eaten by wild animals.

Interestingly, Bhutanese farmers do not tend to associate crop failures with the possibly poor fertility state of their soil or their maybe inadequate management. They regard soil fertility as "inherent" feature of the soil and rather identify more "visible" causes such as pests, diseases or bad weather as main causes for bad harvests (Norbu, personal communication).

More than once I wondered what happens now, that humans have increasing capabilities to control and positively influence crop yields through fertilisers and pesticides. Will it render the influence of deities and spirits less important? Will one of the "strongest indigenous social force(s) in nature conservation" (Kinga 2001) simply disappear? Karma Ura notes that "spirits and gods do not hinder people any more from developmental steps being harmful to nature" (quoted in: Hargens 2002). As an example, *zeitgeist* seems to have found a different approach to crop losses by wild animals: according to the 9<sup>th</sup> plan, the problem shall be addressed by "prescribed and controlled culling of prolific pest species like wild boars" (p. 118). The "prescription" may however take account of non-material considerations, e. g. religious sensitivities.

A clear way to portray these multiple dimensions which have to be considered for integral, holistic development, namely Wilber's four-quadrant model, has been introduced to the GNH discussion by Sean B. F. Hargens (2002). I have tried to use this approach to outline the complex "relationship" between humans and soil (Figure 1).

Figure 1: Four-quadrant analysis of the relationship between humans and soil

Interior-Individual	Exterior-Individual
Psychological joy about good crop growth, fear for crop failure (loss of income) identification with land, pride of possession positive/negative emotions towards labour of land use Spiritual direct interference with local deities during fieldwork	Behavioural ploughing crop planting fertiliser/pesticide input protection of crops against animals (e. g. wild boar) harvesting
“Agri-Cultural” specific land use techniques (type of crops, time and mode of planting, ploughing etc. ) specific land use patterns (bare fallows, <i>tseri</i> cultivation) Religious success/failure of activities indicate “mood” of local deities crop loss to wild animals sometimes viewed as offerings to appease local deities	Ecological soils as habitat for animals and plants storage and filter medium biological-chemical “reactor” (nutrient cycling) Sociological distribution of farm land within the community (size, location, fertility) exchange of harvested products (barter) cooperation with RNR-RC (extension agents) participatory development
Interior-Collective	Exterior-Collective

**The Middle Path**

From the above, I think it has become clear that soils play a key role within man’s and nature’s existence and coexistence. Soils can rightfully be counted among a nation’s most valuable possessions. “A nation that destroys its soils, destroys itself” (Roosevelt 1937). It is therefore justified to make soil conservation a top priority in national politics.

The challenges ahead in the agricultural sector are considerable, and often first results from development seem confusing or contradictory. Let me name two examples:

Farm mechanisation: simplifies people’s life and makes farming more attractive for the young generation, thus counteracting rural depopulation; but unchallenged mechanisation leads to accelerated loss of soil fertility (as described above), further decrease of job opportunities, further income inequalities, decrease of cattle (resulting in reduced nutritional supplements, less manure and nutrient transfer from forests to fields, and reduced possibility to manage grazing land) and degradation of unpaved farm roads by heavy machines.

Inorganic fertiliser input: causes fast crop response, helps to alleviate hunger and poverty; but over- and improper use is likely to have negative effects a) through their mining, production and transport, and b) on the fields in the long term: urea and suphala have acidifying effect; urea may trigger nutrient imbalances in fields (because only N is added, and natural soil K and P are depleted, “mined”); suphala adds P, which may cause eutrophication in neighbouring water bodies; furthermore: fertiliser is expensive and causes dependency on specific companies and countries.

I have written this manuscript with the conviction that Bhutan will be able to handle the considerable challenges ahead: Firstly, the concept of Gross National Happiness is in itself a holistic one and provides the multi-dimensional approach needed to embrace all relevant material and spiritual levels associated with soil conservation. There is no need to adopt “foreign” policies like e. g. Agenda 21 (UNCED). The idea of sunyata, the “interrelatedness” of all things is of further help.

Secondly, the Buddhist “Middle Path” will be the guideline to avoid the pitfalls of extremes. In spite of the possible and partly already visible negative impacts on soil, development need not be stopped, but pursued in a carefully, balanced way. The philosophy of GNH will have to lead to a sound management philosophy and sustainable resource management in practice. Only if this venture succeeds, emerging conflicts as between agricultural intensification and natural conservation may be solved.

Numerous concepts have been developed outside Bhutan to guarantee sustainable agricultural development. The one which - in my opinion - comes closest to the GNH approach, has been termed “Low External Input Sustainable Agriculture” (LEISA). Hilhorst & Toulmin (2000) describe it as follows: “LEISA promotes the use of ecologically sound techniques which are based on understanding of agro-ecosystems, while building on farmers’ knowledge and experience. Its methods aim at strengthening the internal dynamics of these agro-ecosystems, using resources that are locally available, complemented by external resources only when alternatives do not exist. The approach also aims to boost farmers’ self-reliance, protect local values and preserve biodiversity [...] and makes intensive use of participatory development.

In the following sections I will give some ideas, what soil fertility management implies at the operational level and how the necessary steps may be organised.

### **Operational levels**

Analogous to the GNH constituent of good governance as a guideline for the country’s administration, a catalogue of measures to ensure good farming practice is being developed by NSSC and other technical branches of MoA and promulgated by the Extension Services.

At field level this means maintaining or enhancing organic matter input. Norbu (1997) has shown that the management of organic nutrient sources such as animal dung, forest litter and crop residues is an integral part of the indigenous land use systems in Bhutan. Experiences about land use techniques are transferred from one generation to the next and adjusted to the various soil types, having mainly been identified and grouped according to their colour, water retention and workability. Regarding organic matter input, nature and handling of these amendments may strongly vary depending on climate, socio-economics and soil types. Especially in the western regions, farmyard manure (FYM), produced by mixing animal dung, forest litter and crop residues, is the main form of organic input. Maintaining the existing integrated crop and livestock systems is therefore of high importance for the fertility of the soils.

After harvest, pooled and dried stalks, stubbles and weeds are being collected, decomposed and incorporated before the land is again prepared. Additional sources of organic material comprise kitchen residues (if not fed to pigs) or any other form of organic waste.

In some places, the burning of pooled organic residues is common practice because it is thought to decrease the weed populations and prevent soil-related diseases. Roder et al. (1993) report in detail about pangshing, a labour-intensive procedure of burning heaped dry topsoil, using plant biomass or manure and soil organic matter as "fuel". Besides beneficial effects of pH increase, improved K availability and reduced C/N ratio, major disadvantage of this practice are the substantial gaseous loss of N and C, and full exposure to erosion in the initial period after burning. Fallow periods of 15-20 years are required to maintain the sustainability of this land use type.

Enhanced input of N can be obtained by temporarily sowing plants capable of biological N fixation. Intercropping of cereals with peas has been observed from some areas in eastern Bhutan as part of indigenous land use strategies (Norbu, 1997). N and P deficiency have been identified as one of the main causes for rangeland deterioration in northern Bhutan (Gyamtscho 2002). In case of rice farming, the small Azolla fern is traditionally used to increase N inputs.

Apart from being a source of nutrients themselves, organic amendments are proven to enhance mineral fertiliser efficiency, microbial activities and the soil structure in general. This results in secondary beneficial effects like improved aeration, higher water holding capacity, and less inclination to wind and water erosion.

After harvest, mulches, cover crops and certain trees protect the soil from erosion, conserve soil moisture and moderate soil temperature changes. Other mitigation measures against soil erosion include hedge planting, contour ploughing and early action against starting landslides (filling up gullies after monsoon time, planting of trees etc. ). The promotion



of agroforestry – planting crops and trees together – has many proven benefits and is already being promoted through the 9<sup>th</sup> plan.

Last but not least the careful use of pesticides (if not even their abandonment) should be in everybody's self-interest. If a soil is healthy and in good state, it has a high resistance against diseases and might also strengthen the crops to withstand pests.

This short summary is of course far from being complete. The above recommendations are just the most important ones and additional measures will have to be implemented depending on the specific local situations which may strongly vary.

It will be essential to establish some kind of monitoring system to a) collect field data on the current state of Bhutan's soils under different crops, management regimes, different altitudes etc. and b) to choose suitable indicators to assess soil fertility on selected reference sites in regular intervals. Such indicators may include:

- harvest assessments;
- plant available contents of basic nutrients (P, N, K);
- organic carbon contents;
- bulk density measurements; and
- CO<sub>2</sub> production rates (as indicator for biological activity).

Less quantifiable information like individual observations and comments from the local population, the occurrence of land slides and ravines etc. can also be helpful.

Pollution monitoring (as already mentioned among the 9<sup>th</sup> plan environmental objectives) will be another important aspect. The monitoring should be done in appropriate time intervals and the results incorporated as part of the "quantitative measurements" of GNH into a "Gross National Happiness Report" as suggested by Hargens (2002), ideally issued every 5 years. This would give necessary feedback to those responsible to see if the "Middle Path" of sustainable development is still being followed or if soil resources are possibly stressed beyond their capacity.

We have to acknowledge that even if we can plan all things in detail, it is still impossible to plan the change within people. Changes in attitude often take long time or do not occur at all, especially if new regulations are overimposed on the people instead of being carefully communicated.

I am convinced that the transfer of knowledge concerning the "non-material" or even spiritual dimension of soils must not be neglected. In the Western world, experience shows that, with increasing mechanisation of agriculture, people have less contact to soils in everyday life, they are "detached" in the truest meaning of the word. This is in disagreement with the importance of soils, as indicated above, and it also does not reflect the uniqueness, beauty and complexity of this living system, which is admired by countless scientists around the world. And because of this I believe that

there might be a chance to negotiate a smooth transition from a partly fading mystic to a more secular philosophy of soil without questioning the value and significance of the earth underfoot. Regarding the reverence for it, farmer wisdom and scientific understanding are not worlds apart.

Teaching the farmers as the persons in direct contact to the soil will be most effective. Topics could range from practical aspects like promulgating and discussing successful and innovative sustainable land use strategies, as well as rather theoretical information and advice on soil fertility maintenance and erosion control. A good example of how agricultural teaching can be implemented within already existing projects is RSPN's Integrated Conservation and Development Programme (ICDP) in Phobjikha valley (RSPN 2003): although the main purpose is to conserve the rare Black-necked Crane (*Grus nigricollis*), educating farmers on the significance of soil and water conservation, environmental protection, erosion control and soil fertility maintenance can be found among the agricultural project activities.

School books portraying soils more vividly and pointing out our dependence on and responsibility for them more clearly, will be a worthwhile investment. It can be pointed out that the soil-humans relationship is characterised by taking (harvest) and giving (fertiliser, organic material). Simple field exercises, where children could learn about soil life, e. g. by using plastic beakers with a magnifying lid ("bug boxes") could easily be conducted.

In higher classes, the concept of sustainability and nutrient recycling may be explained using soils as an example. Workshops for personnel in agriculture administration at various levels could build up on the same idea.

The important thing will be, that communication takes place at all. It will offer opportunities for joint learning and research between farmers, researchers, extension agents, administrative personnel and all other involved persons. One example can be the task of understanding and documenting the various traditional soil management systems existing in different parts of the country as recommended by Norbu (1997).

### **Organisational Levels**

Many people at various levels are involved in the process of sustainable soil fertility management. With the bottom-up approach of participatory development, a most suitable development option has been chosen, placing the land users in the centre of the approach. This policy is ideal because it involves farmers at the base of the process, encourages them to analyse the problems they face and accelerates the acceptance of new technologies and concepts. Indigenous knowledge in combination with local initiatives will be able to provide the keystone of agricultural improvement and develop site-specific solutions, on which all complementing programmes can build on.

As a consequence, as Karma Ura (quoted in Gurung 1999) named it, “a sense of control, ownership and responsibility for the maintenance of collective local resources that had declined with a concomitant rise in the bureaucratic power” will develop (or at least not get lost).

Extension agents (EA) from the geogs and districts are in contact with farmers and can act as multipliers for implementing soil fertility management by providing advice, distributing new seedlings, documenting and communicating successful and innovative indigenous sustainable strategies. They may also exert some on-site-encouragement of good farming practices and provide feedback for agricultural administration and RNR-RCs.

The identification of suitable soil reference sites and their regular sampling, as well as measurement of the suggested soil parameters above (“indirect GNH indicators”), could be conducted by the National Soil Services Centre (NSSC, Simtokha). NSSC is already involved in the sampling of dry land, wet land and orchard soils with samples from around 700 household being processed. The current study aims at detecting and quantifying changes in selected soil properties in association with high mineral fertiliser inputs, continuous cropping of tuber crops (e. g. potato with maize), and switching from traditional to improved crop varieties.

The NSSC also acts as “interface” between soil fertility research and its field application. It is the ideal body, where useful know-how, technologies and innovations in terms of sustainable soil fertility management from outside Bhutan can be identified, thus combining external and indigenous sources of knowledge and narrowing the divide between researchers and “beneficiaries”.

The complex and multi-dimensional nature of soils has necessarily resulted in laws, regulations and development goals having developed in various sectors, e. g. agriculture & horticulture, forestry, environment and rural development. Another task for the NSSC to perform could therefore be to coordinate all policies related to the management of soils in order to identify possible conflicts at an early stage and thus avoiding unnecessary dissatisfaction. The overall aim in this respect could be to formulate a national action plan for sustainable soil fertility management.

On geog (GYT) and dzongkhag (DYT) administrative level, the process of sustainable soil fertility management must have high priority. Good governance for policy makers on this level could mean raising and maintaining a high level of consciousness about soil related questions like:

What data are available on soil degradation for different regions of Bhutan? How reliable is this information and what is the estimated impact on livelihoods, national economy and environment?

Where soil degradation is significant, is it reversible at an economically reasonable cost?

How might improved soil fertility management contribute to achieving more sustainable rural livelihoods?

Is structural change in the rural economy bringing a shift in rural people's reliance on soil resources, and how does this affect their management practices?

In what areas is there a need for special policies and public/private funding to improve soil fertility management?

What should be the role of various stakeholders in setting priorities and designing interventions? How can their role be strengthened by using more effective participation by farmers and other rural operators in decision-making and implementation? (from: Hilhorst & Toulmin, 2000).

On their highest levels, government & administration will have to agree on a policy framework containing clear concepts about influencing input and output prices for agricultural products (and fertilisers), improving market arrangements (e. g. finding new markets for agricultural products like export of "organic" food to India, export of red rice to Europe/America), facilitating credit provision, supporting existing institutions (e. g. RNR-RCs), initiate communication and training, changing research and extension approaches, investing in rural infrastructure, promoting diversification of the rural economy and similar incentives to encourage farmers and other stakeholders to behave in desired ways. Naturally, farmers with access to markets and other infrastructure are more likely to adopt improved soil fertility management practices. To reach a more balanced level of happiness, the focus of these activities should therefore generally be on areas already subjected to soil degradation and those parts of the country having been identified as poor, remote etc. at present.

These emphases are not new and most of these topics are already being addressed and promising ideas for the future (e. g. identification of several centres for urban growth) have been developed.

According to the Bhutan 2020 document, about half of the population will still live in rural areas by 2020 (RGoB 1999a, p. 73). Maintaining the sustainability of the farming sector as a significant source of food, incomes, social identity and employment opportunities is therefore likely to be vital to the overall concept of GNH even in the long term.

## **Conclusions**

Soils are an integral element of GNH. They are connected to all its major constituents, and this is why I believe that the sustainable management of this vital natural resource can also be based on the GNH philosophy. The holistic approach in combination with the Buddhist principle of the "Middle Path" has the potential to avoid the danger of mere technocratic implementation of development goals, which could have devastating effects on Bhutan's fragile mountain ecosystems in general and

its soils in particular. It encourages including spiritual and environmental aspects of soils into the overall equation, and thus guarantees a balanced weighing of all involved interests, be it human or non-human.

Despite the present satisfactory situation, we must face the fact that with the current setting of rapidly growing population and increased human development activities, the material interest in soils as “production factor” may become of predominant importance in the future.

Nevertheless I want to conclude with the positive note that steps taken to enhance the state of the soils are likely to have favourable influences not only in one direction but several ways. Sustainably managed soils are healthy and fertile, resulting in material gain for man (crop success) and nature (minimum interference), psychological gain (stable income enlarges people’s choices) and last but not least hopefully maintain the reverence we feel for the “invisible mother of the farm” .

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