



Farmers knowledge of soil fertility in West-Central Bhutan

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ABSTRACT

Farmers have unique indigenous knowledge on their farming practices and soil management systems which is their basis for farm-level decision making. However, studies capturing relative importance (weightage) of indicators of soil fertility are scarce. In total, 75 households or 24% of the households in Guma block in West-Central Bhutan were surveyed to capture the farmers' perceptions on the indicators of soil fertility. Further in a half-day focused group workshop, pairwise comparison between the soil fertility indicators was performed employing the Analytical Hierarchy Process (AHP) to determine the relative importance of the indicators. Rank sum and rank reciprocal methods were also used to compare with the outcomes of the AHP. The farmers' 10 most important indicators of soil fertility were: crop yield (mentioned by 100% of the households), soil texture (86.7%), soil color (92%), soil compactness (92%), soil depth (48%), response to manure/fertilizer (18.7%), stoniness (17.3%), weediness (18.7%), soil workability (12%) and land slope (14.7%). The workshop results by three methods showed the crop yield to be $\geq 33.3\%$ weight (value) followed by four indicators of soil texture ($\geq 16.5\%$), color ($\geq 14.6\%$), compactness ($\geq 10.9\%$) and depth ($\geq 6.7\%$). Farmers soil fertility indicators were found to relate to the attributes that they can measure, see or feel. The key indicators and their relative importance were as crop yield >> soil texture > color > compactness > depth. Crop yield was considered most important because it is easily measurable to the farmers and it reflects the farmers concern for household food security.

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1. Introduction

Agriculture in Bhutan is highly diversified, integrated and interdependent between crops, livestock and forestry components (Weatherhogg et al., 2001). It has been evolving from subsistence to semi-subsistence agrarian economy where modern science and technological practices are of recent introduction. In rural parts of the country where access to modern agricultural inputs is limited, soil fertility management is traditional and sustainability of the traditional soil fertility management system is dependent on the household labor availability and number of livestock holding (Dorji and Dorji, 2015; National Soil Services Centre, 2011). Even though the traditional soil fertility management systems based on the use of animal manures, leaf litter and crop residues still dominate, the ability to maintain and sustain these indigenous systems is being undermined by emerging socio-economic factors in Bhutan (Norbu and Floyd, 2004).

Elsewhere, rural farmers have unique indigenous or local knowledge on their farming practices and soil management systems. In some cases, the local knowledge is the basis for local-level decision making (Sillitoe,

1998a; Zurayk et al., 2001) in agriculture, health care, food preparation, education, natural-resource management, and a host of other activities in rural communities. The local knowledge is passed on through generations and refined into a system of understanding of natural resources and relevant ecological processes (Pawluk et al., 1992). In combination with scientific knowledge, this local knowledge is used to develop the livelihood strategies of the household or community. However, the obstacle to the viability of indigenous values is the promotion of Western-style economic development initiatives that seldom acknowledge the legitimacy of values outside the materialist-rational paradigm (Groenfeldt, 2003). In Bhutan where all development plans are screened and guided by the philosophy of Gross National Happiness (GNH), which emphasizes on balancing between the materialism and spiritualism. In GNH concept, soil fertility is deemed as the natural capital that supports development of 'Agri-culture' without depleting resource-base following a "good farming practice" (Caspari, 2004). Scientifically, the term 'soil fertility' refers to the nutrient (mineral) status of the soil and is an indicator of the agricultural potential of the land (Teshome et al., 2014). Due to the direct interaction with the particular environment/land, the local people accumulate understanding, skills and technology relevant to their locality and conditions (Dawoe et al., 2012) which becomes local knowledge. This acquired knowledge (ethnoscience) through experience is used for gainful utilization of land and other resources.

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Further, research aimed at improving agricultural and natural resources management is likely to be more effective when local people have a voice in their own development and this approach usually means that research must embrace indigenous knowledge (Pretty, 1995) and this is true for the Bhutanese farmers too. Farmers' knowledge of soil fertility may be used in relation with scientific finding to address issues and problems of soil management to produce a locally informed development plans and interventions of relevance to local people (Karlun et al., 2013; Sillitoe, 1998b). There are numerous studies documenting farmers' indicators of soil fertility or soil quality (Barrera-Bassols and Zinck, 2003; Barrios and Trejo, 2003; Buthelezi et al., 2013; Desbiez et al., 2004; Maro et al., 2014) in different parts of the world and a few in Bhutan on natural resource management

(Wangyal, 2012), on health care systems (Lhamo and Nebel, 2011) and soil fertility management (National Soil Services Centre, 2011). Since the different indicators of soil fertility are not of equal value, and the studies evaluating the relative importance (weightage or value) of between them are scarce this study was undertaken. Hence, to address the knowledge gap the research aims:

- 1) to identify the farmers' indicators of the soil fertility based on their local knowledge and rank them, and
- 2) to determine the degree of importance (value) of the between the identified soil fertility indicators by adopting the Analytical Hierarchy Process (AHP) and ranking methods.

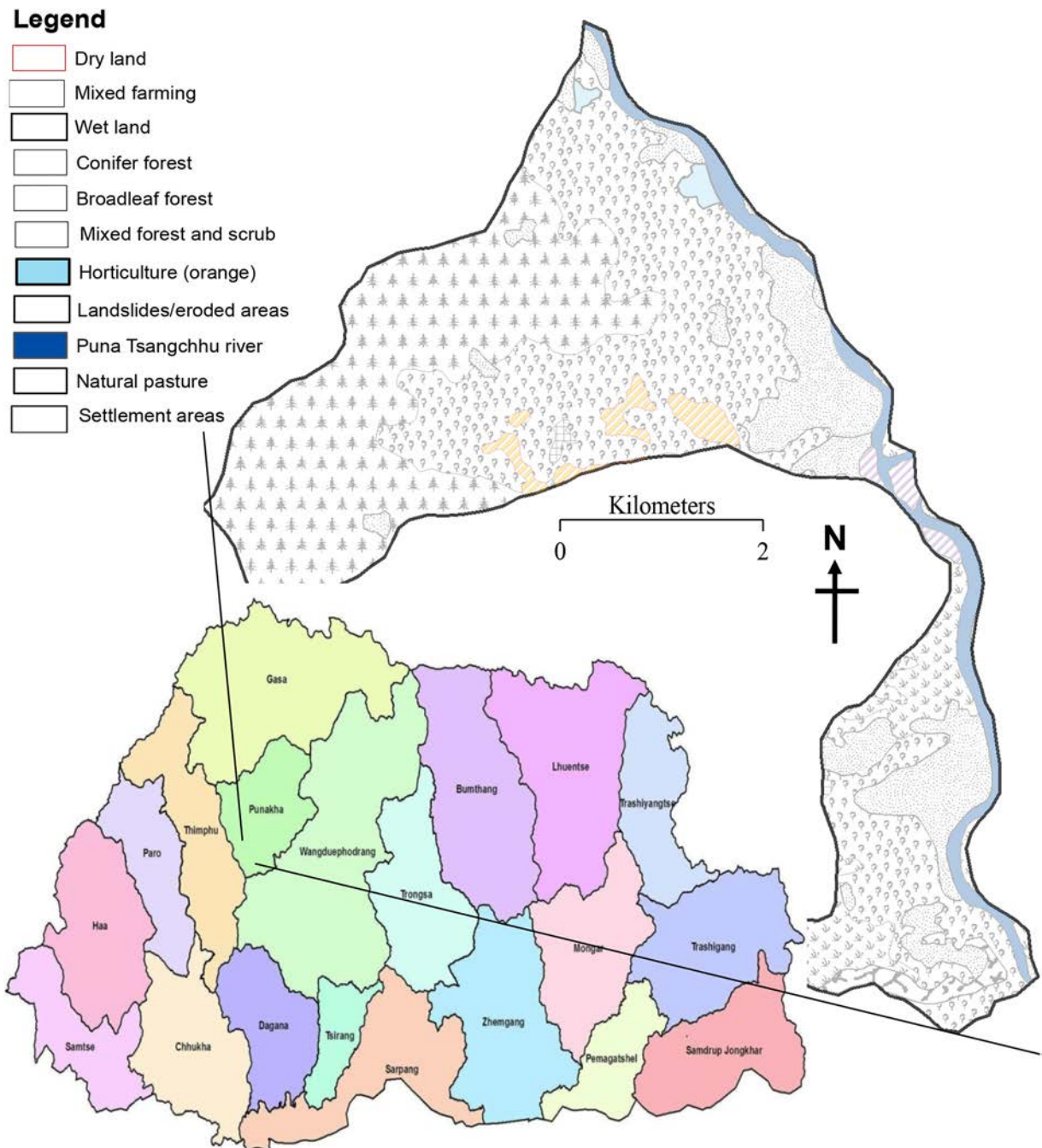


Fig. 1. Study location and major land uses in Guma geog under Punakha district is shown in the map of Bhutan.

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