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Kiphire aspirational district of Nagaland:

Does soil health status help to formulate strategies for agricultural development?

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Nagaland is one among the eight North-Eastern states and is rich in biodiversity. The state comes under the Indo-Burma Biodiversity hotspot of the world. Varied climatic condition ranging from tropical to temperate has resulted in the richness of species diversity in the state. Logically hence, the prevalence of favourable agro-climatic condition for diversified agricultural crops appears to be an important factor for possible agricultural development in the state. However, difficult hilly terrain, poor infrastructure, non-availability of good quality agri-inputs, lack of technical know-how on crop production and improper planning of land resources in view of soil health status have been major constraints with respect to agricultural development in the state. In order to address the issues related to agricultural development in the state, several government schemes are in place. The Transformation of Aspirational Districts initiative of the NITI Aayog, Government of India is one of them. Under this programme, 117 backward districts have been identified in the country, at least one from each state, by the NITI Aayog to promote socio-economic upliftment through overall development of various sectors. Agricultural sector is one of the core areas of focus in the programme.

Keywords: Kiphire, Nagaland, North-Eastern

KIPHIRE of Nagaland is one of the 117 backward districts in India as identified by the NITI Aayog with a thought to harness the possibilities for overall socio-economic development along with a boost in agricultural sector in the district. This is the only district in Nagaland which has been covered under Aspirational district in the state. Kiphire district is located in the eastern most part of the state bordering Myanmar, delimited by Tuensang district in the north, Phek district in the south and Zunheboto in the west. Kiphire stands at 36th rank among the aspirational districts with respect to agriculture sector. Agriculture sector in the district is blessed with adequate rainfall, wide scope of crop diversification due to favourable agro-climatic condition, and possibility of organic agriculture due to less consumption of chemical fertilizers. In order to harness the possibilities, appropriate strategy for agricultural development is of high significance.

Soil is an integral part of agricultural sector and its development. Soil health assessment is a pre-requisite to witness a boost in agricultural production. Soil-test based recommendation, specific to agricultural crop is the need of the hour for sustainable soil health as well as development in agricultural sector. Agricultural development strategy on the basis of soil health status is of tremendous importance since location specific crop production constraints can be identified and addressed through soil testing. Keeping this in view, a soil health assessment programme was undertaken in the Kiphire aspirational district of Nagaland under *Krishi Kalyan Abhiyan* (KKA) initiative of the Ministry of Agriculture and Farmers' Welfare (MOA&FW), Government of India. The *Krishi Kalyan Abhiyan* (KKA) was launched on 1st June 2018 by the MOA&FW with the aim of improving agricultural scenario in the aspirational districts and thereby achieving the target of doubling farmers' income by 2022. Assessment of soil health status of agricultural lands has been one of the important activities under KKA to promote agricultural development in the aspirational districts. Formulation of strategies for agricultural development, in the present case-study, comprised of collection and analysis of soil samples for soil health assessment, interpretation of soil-test results for recommendation, and

development of future strategy for agricultural sector in view of soil health status.

Collection and analysis of soil samples for soil health assessment

Composite surface (0-15 cm) soil samples were collected from agricultural fields under four villages namely, Chomi, Salomi, Anatongre and Kiseteng of Kiphire aspirational district of Nagaland. In total, 61 geo-referenced soil samples were collected using GPS during June 2018. Soil samples were collected mostly from the fields where maize and paddy were grown under shifting cultivation (*jhum*) on the hill slope. Besides, soil samples were also collected from the orchards under apple, pineapple and large cardamom. Field moist soil samples were air-dried, ground and passed through 2 mm sieve at ICAR-National Bureau of Soil Survey and Land Use Planning, Regional Centre, Jorhat for further chemical analysis. In order to assess soil health status, soil samples were analyzed for 12 important parameters namely, *p*H, EC, organic carbon, available nitrogen (N), phosphorus (P), potassium (K), sulphur (S), zinc (Zn), copper (Cu), iron (Fe), manganese (Mn) and boron (B) following standard procedures.

Table 1. Soil health status of Kiphire aspirational district of Nagaland

Parameter	Value	Inference
Soil reaction (*p*H)	4.30–6.55 (5.41±0.56)*	Extremely acidic to slightly acidic in nature
Electrical conductivity (EC) (dS/m)	0.01-0.05 (0.02±0.01)	Non-saline
Organic carbon (%)	0.59 to 4.89 (2.84±1.05)	High
Available N (kg/ha)	141-572 (344±112)	Mostly medium status
Available P (as P_2O_5) (kg/ha)	29.6-68.9 (50.0±10.2)	Medium to high
Available K (as K_2O) (kg/ha)	112-396 (245±72.8)	Mostly medium to high
Available S (mg/kg)	14.9-32.4 (25.9±2.38)	High
Available Zn (mg/kg)	0.22-5.30 (1.32±1.16)	Mostly sufficient
Available Cu (mg/kg)	0.21-3.96 (1.77±0.81)	Sufficient
Available Fe (mg/kg)	47.4-194 (113±38.9)	Sufficient
Available Mn (mg/kg)	5.47-120 (39.3±26.3)	Sufficient
Available B (mg/kg)	0.22-0.74 (0.39±0.09)	Mostly deficient

*Figures in parenthesis indicate (mean±standard deviation).

Interpretation of soil test results for recommendation

Soil test results are summarized in Table 1. Results indicated that soils were acidic in reaction with the mean *p*H value of 5.41 (strongly acid). The EC values indicated that soils were non-saline in nature. Organic carbon content of soil ranged from 0.59 to 4.89% with the mean value of 2.84%, which indicated that soils were rich in organic carbon content. As far as the availability of primary nutrients (NPK) is concerned, soils

ICAR-National Bureau of Soil Survey & Land Use Planning (NBSS & LUP)
(INDIAN COUNCIL OF AGRICULTURAL RESEARCH)
Regional Centre, Jorhat (Assam)

Soil Health Card No : NL/K/PN/1902/696
Name of Farmer : Sulenthong Yimchunger
Validity : From 2018 to 2021

SOIL HEALTH CARD — **ICAR- NBSS & LUP, Regional Centre, Jorhat (Assam)**

Farmer's Details

Name	Sulenthong Yimchunger
Address	Choni
Village	Choni
Block	Pungro
District/State	Kiphire, Nagaland
Adhaar No. / ID	766053587573
Mobile No.	9862304454

Soil Sample Details

Soil Sample No.	N/K/C-9
Khasra/ Dag No.	---
Sample Collected	Ginger field
GPS Location	25°51'28.99"N 94°51'42.65"E
Surface Texture	loamy

SOIL TEST RESULTS

S. No.	Parameters	Test value	Range
1	pH	5.60	Moderately acidic
2	(E.C.) (dS/ m)	0.04	Non-saline (0-4)
3	Organic Carbon (O.C.) (%)	1.86	High (0.50-0.75)
4	Available Nitrogen (N) (kg/ bigha)	60.2	Medium (37-75)
5	Available Phosphorus (P_2O_5) (kg/ bigha)	9.10	High (4.5-9.0)
6	Available Potassium (K_2O) (kg/ bigha)	27.7	Medium(18-45)
7	Available Sulphur (S) (kg/ bigha)	7.52	Sufficient (>3.0)
8	Available Zinc (Zn) (kg/ bigha)	0.16	Deficient (<0.18)
9	Available Boron (B) (kg/ bigha)	0.11	Deficient (<0.15)
10	Available Iron (Fe) (kg/ bigha)	30.2	Sufficient (>1.3)
11	Available Manganese (Mn) (kg/ bigha)	9.66	Sufficient (>0.60)
12	Available Copper (Cu) (kg/ bigha)	0.61	Sufficient (>0.06)

Secondary & Micronutrient Recommendations

S.No.	Parameters	Soil Applications
1	Manganese (Mn)	Not necessary, since present in sufficient concentration
2	Sulphur(S)	
3	Copper (Cu)	
4	Iron (Fe)	
5	Zinc (Zn)	Zinc Sulphate @3.33kg/bigha
6	Boron (B)	Borax @ 10 kg/ ha or 1.3 kg/ bigha for vegetables

General Recommendations

1	Organic Manure	Well decomposed FYM @ 5-10 t/ ha during land preparation
2	Lime	Calcium carbonate @ 4 t/ ha or 5 q/ bigha at every alternate year during land preparation

5th December World Soil Day

Fertilizer Recommendations for crops

S. No.	Crop	Variety	Fertilizer Combination-1 for N-P-K (Rain-fed)	Fertilizer Combination-2 for N-P-K (Irrigated)
1	Upland paddy	Local	N: P_2O_5: K_2O = 60: 26: 30(kg/ ha) Urea-18, SSP-22, MOP-7 (kg/ bigha) FYM= 10 t/ ha or 1300 kg/ bigha	–
2	Irrigated paddy	Local	–	N: P_2O_5: K_2O = 40: 26: 30 (kg/ ha) Urea-12, SSP-22, MOP-7 (kg/ bigha) FYM= 10 t/ ha or 1300 kg/ bigha
3	Maize	Local	N: P_2O_5: K_2O = 40: 26: 20 (kg/ ha) Urea-12, SSP-22, MOP-5 (kg/ bigha) FYM= 10 t/ ha or 1300 kg/ bigha	–
4	Soybean	Local	N: P_2O_5: K_2O = 20: 51: 40 (kg/ ha) Urea-6, SSP-43, MOP-9 (kg/ bigha) FYM= 10 t/ ha or 1300 kg/ bigha	–
5	Pigeon pea	Local	N: P_2O_5: K_2O = 10: 34: 20 (kg/ ha) Urea-3, SSP-29, MOP-5 (kg/ bigha) FYM= 10 t/ ha or 1300 kg/ bigha	–
6	Ginger	Local	FYM= 5t/ ha or 1300 kg/ bigha	–

Soil health card for dissemination of location specific recommendations based on soil health assessment

Table 2. Strategies for agricultural development in Kiphire aspirational district of Nagaland in view of soil health status

Soil health issues	Strategies for consideration
Soil acidity	• Inventory of land resources and appropriate land use plan. • Selection of appropriate crop based on soil-site suitability and land evaluation for higher profitability. • Amelioration of soil acidity using locally available liming materials such as paper mill sludge.
Maintaining high soil organic carbon status	• Adoption of appropriate soil conservation measure on hill slope to reduce soil erosion and loss of organic carbon. • Suitable land use plan for improved *jhuming*. • Assessing feasibility of agro-forestry systems for adoption under *jhum*.
Emerging deficiencies of micronutrients in soil	• Periodic monitoring of soil health status. • Adoption of corrective measures based on soil test results. • Use of organic manure and popularization of integrated nutrient management (INM) for crop production.
Harnessing benefits of high soil organic carbon	• Promotion of organic farming for high value crops namely, apple, large cardamom, pineapple, etc. status based on soil-site suitability assessment. • Delineation and prioritization of organic farming zones on the basis of organic carbon status of soil. • Ensuring proper certification for the organic produce and appropriate market for the same.
Maintaining nutritional status of soil in respect of major nutrients	• Adoption of soil-test based nutrient management practices specific to agricultural crops instead of blanket recommendation.

were in the category of medium to high fertility status. Availability of S was high in the analyzed soil samples. The availability of micronutrients namely, Cu, Fe and Mn was also sufficient in the soil samples. However, available Zn content, although was sufficient in most of the soil samples, about 34% of the total soil samples analyzed were deficient in available Zn content. Boron contents in most of the soil samples (94% of total samples) were below the critical limit of deficiency (0.5 mg/kg). The key findings of the soil health assessment indicate that soils of the Kiphire aspirational district are acidic in reaction with high organic carbon content and deficient in B availability. The present study also indicates the emerging deficiency of Zn in soils of Kiphire. Boron deficiency in soils of Kiphire may be attributed to the leaching loss and high soil organic carbon content. Similarly, Zn deficiency may also be attributed to the highly leached condition of acid soils.

Based on the soil test results, location specific recommendations were made for important crops being grown in the district. Soil health cards were distributed to the farmers for the dissemination of site-specific recommendations and their possible implementation based on soil health assessment.

Strategies for agricultural development in Kiphire aspirational district

A framework on the future strategies for agricultural development in Kiphire has been developed in view of soil health status of the district (Table 2). Soil health assessment and interpretation of soil test results indicate few important soil health issues for consideration in the district. These include soil acidity and emerging deficiencies of micronutrients in soil. Besides, maintaining the fertility status of soil in respect of major nutrients namely, N, P, K and S for long-term also appears to be an important soil health issue. It is apparent that the soils of Kiphire are rich in organic carbon content. Therefore, for harnessing the usefulness of high organic carbon content of soil, appropriate strategies are required. Since soil organic carbon is a highly vulnerable component of soil, particularly in the hilly terrain, maintaining high soil organic carbon is also a challenging soil health issue in the district.

SUMMARY

Soil health assessment is a prerequisite for any developmental planning related to agriculture. The present study indicated that soil analysis for important properties is essential for formulating future strategies for development in agriculture. The study also emphasized that due attention must be given to generate soil resource information for developing any strategic plan with respect to agricultural sector, particularly for aspirational districts. Besides, adoption of appropriate soil conservation measures, particularly for hill districts, is of practical significance for sustainable agricultural development. Periodic monitoring of soil health status is also essential for addressing emerging crop production constraints.

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Cropping Season and Fertilizer Requirment

To ensure adequate availability of fertilizers, Department of Agriculture and Cooperation (DAC) assesses requirement of major fertilizers before each cropping seasons. The assessment is made based on requirements projected by State Governments/UTs, past consumption, weather conditions, targeted area, cropping pattern, area under irrigation etc.

Most ideally, fertilizer requirements should be assessed on the basis of nutrient needs of the crops and cropping systems in a particular area (block, district, and state) commensurable with existing nutrient deficiencies. This will ensure balanced fertilization and also ensure availability of needed fertilizers, in particular, secondary and micronutrients which very often farmers do not get at right time and right place. IFFCO has made soil testing service robust and performing to ensure adoption of site specific nutrient management. The Government has rightly initiated the scheme of soil health cards which will help farmers to know about soil health.

— Editor