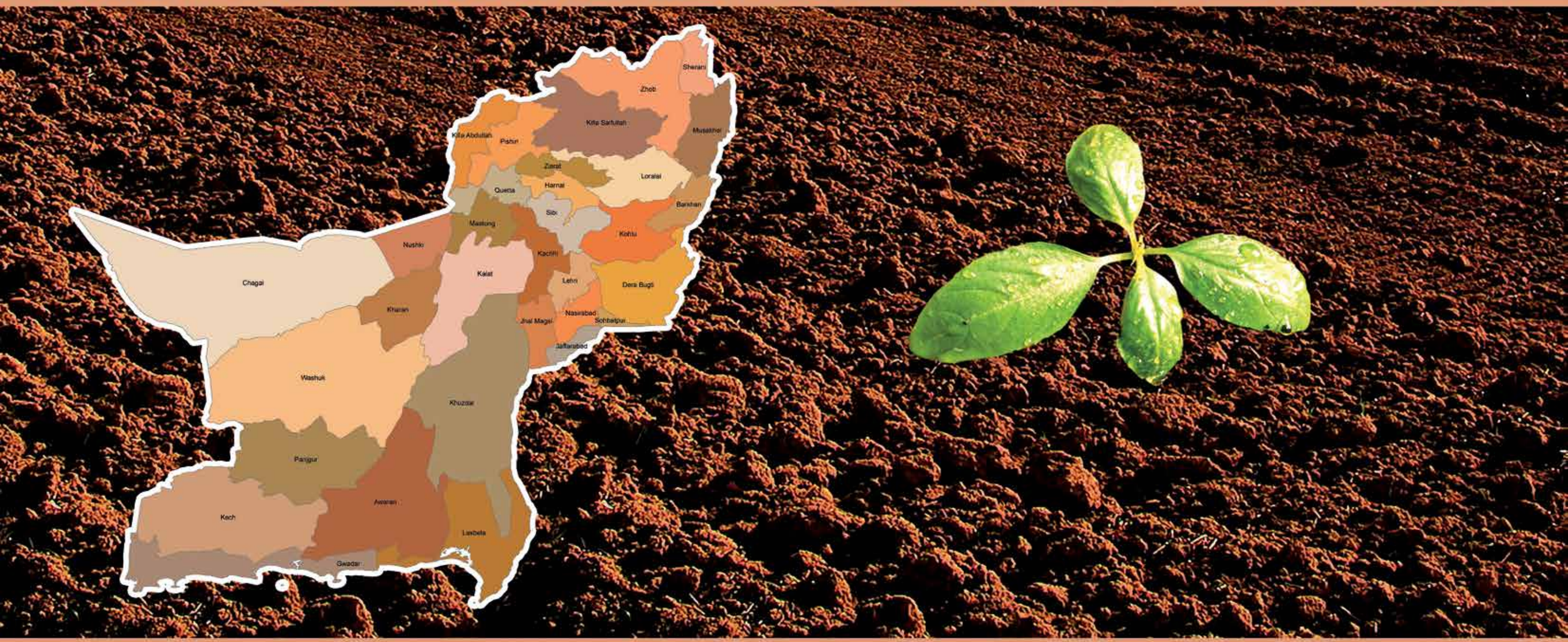
SOIL FERTILITY AND INPUTS USE ATLAS OF PAKISTAN

The Balochistan Province



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Note for the Readers

The objective of this Atlas is to present information regarding nutrients and fertilizers, farmers' common practices, crop yields under different nutrient use scenarios and cropping system in Balochistan province. The overall trends and inferences drawn are valid (and justified) primarily for a particular crop grown under the respective zone suitable for that crop. However, variations from the normal trends may be noticed for a crop's yield viz-a-viz fertilizer use when grown on a small area in any crop production zone not specific for that crop. Therefore, the stated patterns and conclusions may be viewed in the perspective of the available data sets, assumptions for interpretations and the methodology adopted rather than making comparisons with a given site specific situation. All possible care has been taken in data analysis and presentation; suggestions for improvements are welcome.

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FOREWORD

The agriculture sector is playing a vital role in driving economic growth in Pakistan. About 67% of the country's population is directly or indirectly dependent on agriculture for their livelihood. The agriculture sector accounts for 45% of employment equivalent to 26 million persons of the national workforce and 21% of the country's GDP. Adequate and timely use of inputs like balanced fertilizers and certified seeds along with mechanized farming and provision of agricultural credits are prerequisites for better agricultural output. Balochistan province contributes significantly to the overall national agricultural production in field crops (13%),fruits (76%) and vegetables (11%).Thus, the economic development of the province in the context of ever increasing population largely depends on further growth in agriculture sector.

The promotion of sustainable soil management is essential for meeting over arching human need for food, raw materials and energy. Among the major constraints that hamper sustainable yields are imbalanced fertilizer use and high fertilizer prices. 4R nutrient stewardship, if implemented, can help to decrease the cost of production and enhance fertilizer use efficiency. The Soil Fertility Atlas is a part of the project '4R Nutrient Stewardship for Sustainable Agriculture Intensification in Pakistan: Baseline Input Atlas and Promotion of Best Soil Management Practices' - GCP/PAK/143/USA'. The ultimate objective is to promote and encourage the use of balanced inputs and Right fertilizer/nutrient at the Right rate at the Right time in the Right place (4Rs) in partnership with the public and private sectors. Soil fertility losses in many developing countries of the world are confronting immediate threat to food security. Soil nutrients mining due to intensive cultivation and unsustainable soil management practices is one of the major causes of depletion of the soil fertility. Fertilizers constitute the most important scientific breakthrough in feeding the growing population of Pakistan and elsewhere. The Food and Agriculture Organization, National Fertilizer Development Center, Pakistan Agricultural Research Council and Research organizations in the country have reported up to 50% enhanced crop productivity with the use of fertilizers. However, imbalanced use of fertilizers (nitrogenous, phosphatic, potassic and micronutrients) and low fertilizer(s) use efficiency still remain the major constraints in enhancing crop productivity in the country. The imbalanced use of fertilizers in Pakistan results in lower incomes of the farmers that can rightly be blamed to incorrect ratio of nutrients. Consequently, the agricultural production per unit area especially of cereal crops has been stagnant in some of the cropping zones. On the other hand, the population is increasing at an alarming rate; it requires sustainable agriculture intensification. Organic manures, which can help restore soil health and its nutrient status, offer a huge potential. However, organic manures alone cannot meet the sizeable nutrient requirements of major crops. Therefore, the concept of integrated plant nutrition management system is need of the hour. This is especially true for soils that have been depleted of their plant essential nutrients by intensive as well as exhaustive cropping over decades.

The Soil Fertility Atlas for the Balochistan province provides a comprehensive insight of the latest soil fertility status, local best management practices, fertilizer use trends at the farm-level and management strategy for normal and problematic soils for resource based improvement. This document will help to understand the soil fertility management changes required for sustainable agricultural intensification in the Balochistan province that would also be applicable and extendable to other similar zones across the country. Hopefully, an array of stakeholders will be benefitted from this Atlas including farmers, extension workers, research scientists, economists and policy makers in the public as well as private sectors. Specifically, the farmers are deemed to benefit the most. Farmers need to get involved in applying the 4R nutrient strategy for ensuring sustainable resource management as there is a close association between soil fertility management and soil health. Moreover, the soil fertility database would also provide a basis for the development of an improved capacity for monitoring and management of fertilizer use in Pakistan. This will also pave way to upscale the activities concerning 4R nutrient stewardship in other provinces.

At the end, let me express my deep appreciation for those involved in this undertaking of monumental national importance. I have no doubt that this document will go down as vade-mecum for scientists, researchers and policy makers. It will also help to develop an assertive vision for progress and prognosis in the soil fertility protocol in Balochistan.

Mr. Sahibzada Muhammad Mehboob Sultan
Federal Minister
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The preparation of the Balochistan Soil Fertility Atlas has been led by Dr. Waqar Ahmad (Soil Scientist - Project Lead, FAO Pakistan; National Focal Person Asian Soil Honorary Associate, School of Life and Environmental Sciences (SOLES) The University of Sydney, NSW Australia). The kind support extended by Dr. Nisar Ahmad, Ex-Chief of the National Fertilizer Development Center (NFDC), in the form of technical discussions and feedback helped to finalize the fertilizer offtake trends and data interpretation is highly acknowledged. Thanks are also extended to his successor Mr. Abdul Jalil Marwat (Chief NFDC), Dr. Ahmad Ali Khan and Dr. Muhammad Islam (Assistant Chiefs NFDC) for sharing data on fertilizer offtake and postulation of different hypotheses for data interpretation. The support from Prof. Dr. Riaz H. Qureshi (Ex-Vice Chancellor, University of Agriculture, Faisalabad; Ex-Advisor to Higher Education Commission of Pakistan), Dr. Muhammad Yaseen and Dr. Ghulam Murtaza (Professor Institute of Soil and Environmental Sciences, University of Agriculture, Faisalabad), Mr. Malik Rahim Bux (Ex-Deputy Director Soil Survey, Punjab), Sheikh Riaz-ul-Amin (Senior Research Officer, Soil Survey) and Prof. Dr. Mohammad Jamal Khan (Chairman, Department of Soil and Environmental Sciences, The University of Agriculture, Peshawar, and Soil Expert representing International Technical Panel on Soils of FAO - ITPS) in finalizing district-wise dominant soil series, identification of soil parent material and soil classification is highly acknowledged. Thanks are extended to Dr. Muhammad Salim (Ex-Member Natural Resources, PARC), Dr. Samina Siddiqui (Assistant Prof., National Center of Excellence in Geology, University of Peshawar) and Dr. Muhammad Aslam (Principal Scientist, NIAB, Faisalabad) for their guidance on the identified soil management problems and development of key messages for the farming community. Thanks to Mr. Yuji Niino (Technical Officer, FAO Rome), Mr. Ronald Vargas (Land and Water Officer, FAO Rome), Ms. Zainab Bazza (Soil Scientist for the Global Soil Partnership, FAO Rome), and other team from GSP who contributed in finalizing key messages. Thanks to National Fertilizer Companies including Fauji Fertilizer Company Limited (FFC), Engro Fertilizers Limited, and Fatima Fertilizers Company Limited/Pak Arab Group shared information on soil and water testing facilities available for farmers in Balochistan. Special thanks are due to the Fauji Fertilizer Company Limited for sharing soil fertility of various districts of Balochistan through Farm Advisory Centers. Dr. Muhammad Javed Tareen (Director General, Agriculture Research Balochistan) and Mr. Inam-ul-Haq (Director General, Agriculture Extension Balochistan) were proactive in providing information on the existence of district level soil and water testing laboratories and supported the initiative of site specific fertilizer use - an integral part of 4R Nutrient Stewardship.

The editorial comments on the final product were provided by Dr. Waqar Ahmad, Dr. Mohammad Jamal Khan, Mr. Zeeshan Mustafa, Dr. Khalid Mahmood (Ex-Deputy Chief Scientist, Nuclear Institute for Agriculture and Biology (NIAB), Faisalabad), Dr. Balwant Singh (Professor, School of Life and Environmental Sciences (SOLES The University of Sydney, NSW Australia), Dr. Munir H. Zia (FFC, and Chair Pillar-2 GSP), Dr. Arshad Ali (Senior Director Land Resources Research Institute, NARC) and Mr. Abdul Jalil . The development of this Atlas would have been difficult, if not impossible, without the leadership and oversight of Mr. Farrukh Toirov (Deputy Representative, FAO Pakistan) and Mr. Anthony Bennett (Project Lead Technical Officer FAO Bangkok).

INTRODUCTION

Promotion of sustainable soil, crop and nutrient management practices is a challenge in Pakistan to ensure sustainable agricultural production and maintain environmental quality. A sustainable agricultural production system uses the natural resources efficiently and involves recycling of the organic wastes without any negative impact on soil and the environment. Keeping in view the plant nutrition, the objective is to minimize nutrient losses that occur through erosion, gaseous losses of nitrogen (such as NH_3, N_2O), replenishing nutrients exhausted from the soil through crop uptake and product removal, deep leaching, mismanagement and adsorption/precipitation reactions in soils. The Food and Agriculture Organization of the United Nations (FAO) in partnership with the Ministry of National Food Security and Research (MNFS&R), Pakistan Agricultural Research Council (PARC) and the United States Department of Agriculture (USDA) implemented a project entitled '4R Nutrient Stewardship for Sustainable Agriculture Intensification in Pakistan: Baseline Input Atlas and Promotion of Best Soil Management Practices' - GCP/PAK/143/USA. In this project, the FAO collaborated with public and private sector partners to:

- Identify current soil management practices adopted by the farmers for selected crops;
- Enhance cooperation between the public and private sectors, and present common core messages on the 4Rs (the Right source, at the Right rate, at the Right time, in the Right place) that help the farmers to use quality fertilizer inputs efficiently, improve soil health, soil fertility and minimize losses;
- Strengthen the capacity of relevant provincial and federal agricultural organizations for the implementation of sustainable soil management practices focusing on soil fertility, plant nutrition and data visualization;
- Prepare baseline Atlases on current soil fertility status and soil health management practices; and
- Use outputs of the above activities for decision making at various levels and setting provincial frameworks for agriculture and natural resource management.

To achieve the project objectives, use of balanced fertilizer and 4R Nutrient Stewardship were promoted through a series of events including awareness raising and commodity specific workshops, consultative meetings of stakeholders, seminars and dialogues.

Key recommendations coming out of these events are:

- Development of a nutrient stewardship framework and Manual on 4R Nutrient Stewardship for the farming community of Pakistan;
- Establishment of a public-private partnership for sustainable agriculture intensification in the country;
- Farmers' experiences sharing in devising soil and nutrient management strategy for sustainable crop production; and
- Collaborative efforts to address such issues in the best interest of the farming community.

The Soil Fertility and Inputs Use Atlas of Balochistan Province includes:

1) General Maps, 2) Inputs Use Assessment, 3) Mapping of NFDC Nutrient Offtake Data, 4) District Profiles, 5) Soil Fertility Status, and 6) Key Messages.

Moreover, several annexure show details of the important parameters of the fertilizers data used, the FAO's Voluntary Guidelines for Sustainable Soil Management (VGSSM); and various infographs are printed with the permission from the FAO HQ, Rome. The baseline Atlas provides use of different fertilizers/nutrients for major crops grown in Balochistan province. Yield of different crops varies under different nutrient use scenarios. Also, in different cropping zones, inconsistent relationship between crop yields and application of inputs/fertilizers exists. This indicates the impact of factors other than the fertilizer including soil constraints and inappropriate crop management practices. The desired soil fertility management for sustainable agriculture intensification could, thus, be better understood through the identification of areas/regions that use imbalanced nutrient applications (over or below than required) coupled with low fertilizer use efficiency.

Minà Dowlatchahi
FAO Representative
Pakistan

METHODOLOGY

The informations given in the Atlas is based on the provincial agricultural statistics, field based assessment and the data collected from the provincial, federal departments and other agencies including farmers and private sector. A series of workshops and consultations were undertaken at various locations across the province for gathering information from farmers and sharing experience from the national and provincial stakeholders. Considering the contribution of major crops in agricultural production, wheat, rice, cotton, sunflower and horticultural crops like grape, apple, apricot, cherry, pomegranate, onion, and potato (grown across the Province) were selected to monitor the usage of fertilizers and/or yield trends. The crops contributing to national exchequer were prioritized in analysing different trends, i.e., crop productivity in relation to fertilizer inputs, management practices, and soil quality parameters. The consultations aimed to highlight the significance of 4R nutrient stewardship, differentiate this relatively new concept from the balanced fertilization, identify soil and crop management constraints and suggest best known soil health management practices for sustainable agricultural intensification in the province. Major steps involved in Atlas preparation are described below.

Inputs Use Assessment

The assessment is based on the assumption that fertilizer offtake data (a term used by NFDC Pakistan to describe fertilizer consumption based on the marketing of products) do not necessarily reflect the application of fertilizers at the farm level. This community based assessment was made through the involvement of the Balochistan Agriculture Research, farmers, fertilizer dealers, Extension and Information Department. All national fertilizer companies, including Fauji Fertilizers Company Limited, Fatima Fertilizers Company Limited/ Pak Arab Fertilizers, and Engro Fertilizers Limited, played a vital role in conducting this assessment. A questionnaire was developed in consultation with different stakeholders; and thereafter, district wise farmers' interviews were conducted. The province has 32 districts, namely Awaran, Barkhan, Kachhi, Chagai, Dera Bugti, Gwadar, Harnai, Jaffarabad, Jhal Magsi, Kalat, Kech, Kharan, Kohlu, Khuzdar, Killa Abdullah, Killa Saifullah, Lasbela, Lehri, Loralai, Mastung, Musakhel, Nasirabad, Nushki, Panjgur, Pishin, Quetta, Sherani, Sibi, Sohbat pur, Washuk, Zhob, and Ziarat. There are seven crop production zones (CPZs) in Balochistan. Progressive, medium and small farmers from the seven CPZs in the province were gathered in Quetta. The number of farmers selected from each CPZ was based on the trends of fertilizers offtake in the last ten years. The numbers of farmers selected for the assessment varied depending on the fertilizer offtake and more farmers were selected from the areas with proportionately larger fertilizers offtake. Overall, this sample size was found to be representative when aggregated at the CPZ and provincial levels. The collected data were deemed representative for a group of farmers, as rural communities often follow similar practices as elders decide after consultation in the family. This aspect was also verified by the farmers. The information gathered through this assessment pertains to the use of various fertilizers, yield of major crops, major soil constraints hampering productivity and numbers of farmers availing soil and water testing facility in each district of Balochistan. The validation of such trends in each district was based on field surveys, follow-up interviews, interaction with the famers during commodity-based workshops and discussions with public and private sector.

The arable land in Balochistan is broadly classified into three categories, i.e., shallow, medium and deep soils. The climate of the province is arid to semi-arid continental. It has diversified precipitation pattern varying between 200 and 350 mm per annum, but in some parts rainfall as low as 50 mm per annum is also recorded. Upland areas have severe climates for temperate crop production in West Asia, with scanty and erratic precipitation and substantial cold stress at elevations of 1500 m. Cold resistant, drought tolerant winter crops are required for eastern and southern areas and drought tolerant, short season crops for more western and northern areas. Major crops and the previous nutrients offtake data are arranged district wise according to the following CPZs:

- **Zone-1**

  Districts: Gwadar, Kech, and Panjgur

  Major crops: Dates, wheat, onion and fodder crops

  Fertilizer use (Nutrients tonnes, based on the quantities of N, P and K):1000

- **Zone-2**

  Districts: Chagai, Kharan, Washuk and Nushki

  Major crops: Dates, wheat and onion

  Fertilizer use (Nutrients tonnes): 5000

- **Zone-3**

  Districts: Lasbela and Awaran

  Major crops:Wheat, cotton, onion and fodder crops

  Fertilizer use (Nutrients tonnes): 2000

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- **Zone-4**
  Districts: Kalat and Khuzdar
  Major crops: Dates, wheat, potato, onion, cherry and apple
  Fertilizer use (Nutrients tonnes): 15000

- **Zone-5**
  Districts: Quetta, Pishin, Mastung, Killa Abdullah, Killa Saifullah and Ziarat
  Major crops:Grape, apple, apricot, cherry, pomegranate,onion, potato and sunflower
  Fertilizer use (Nutrients tonnes): 42000

- **Zone-6**
  Districts: Musakhel, Loralai, Kohlu, Barkhan, Zhob, Sherani and Harnai
  Major crops: Wheat, potato, almond, apricot, cherry and pomegranate
  Fertilizer use (Nutrients tonnes): 12000

- **Zone-7**
  Districts: Jhal Magsi, Nasirabad, Jaffarabad, Sohbatpur, Lehri, Kachhi, Sibi and Dera Bugti
  Major crops: Wheat, cotton, sunflower, rice, pulses and fodder crops
  Fertilizer use (Nutrients tonnes): 33000

Regarding the application of different nutrient sources, all farmers regardless of the farm size are applying fertilizers/nutrients in eight different combinations:

N only; NP; NPK; NP + Micronutrients; NP + OA; NP + Micronutrients + OA; NPK + Micronutrients; NPK + Micronutrients + OA, where, N = Nitrogen; P = Phosphorus; K = Potassium; OA = Organic Amendment(s). Moreover, keeping the other factors of production constant, combination and integration of organic and inorganic fertilizer will presumably increase crop yields.

NFDC Offtake Data

The offtake data during the period 2008-2017 from NFDC was used for product wise usage of the fertilizers across the province. Nutrient use data for ten years was averaged and trends were monitored for the seven CPZs. Overall trends of the fertilizers offtake remained comparable across the past several years although minor fluctuations were observed. The patterns regarding fertilizer use also coincided with the farmers except for CPZ-5 and CPZ-7. The used approach suffices for the objectives of the Atlas. The agricultural statistics data and information about the soil and water testing facilities in the province have also been documented which would provide a fundamental baseline for future management and planning of not only nutrient(s) use improving soil health and quality in the province.

Data Mapping and Analysis

Initially, a base map of the province containing the district boundaries was prepared in ArcGIS software to aid geo-spatial mapping and analysis. The results of the Inputs Use Assessment and the fertilizer offtake data presented in the tabular form were linked with vector data of the districts for spatial cum attribute data analysis. Scenarios of fertilizer use were developed and matched with yield responses of various crops at CPZs and/or district level in the province.

Data Visualization

The layout of the Atlas was prepared by incorporating all necessary mapping details. The soil fertility status and fertilizer offtake were mapped under different sections of the Atlas for a general overview and presentation. The fertilizer use information is illustrated in the Atlas in aggregated and cartographic form as well as tabular statistics is presented for each crop and district.

Soil Fertility Status

For increasing crop production and economic returns at farm-level, Fauji Fertilizer Company Limited (FFC) is providing free of cost Advisory Services to the farming community throughout Pakistan since 1981. The company provides soil and water testing facilities through its five mobile Farm Advisory Centers (FACs). Currently, these centers are located at Sargodha, Sheikhupura, Multan, Rahim Yar Khan, and Hyderabad. The laboratories are frequently-moved around in the area to facilitate the farming community of each district. For example, FAC Hyderabad (in Sindh) was previously stationed at different locations including Sukkur, Nawabshah, Mirpur Khas, and Hala. The soil fertility data, which included soil electrical conductivity (EC), soil reaction (pH), organic matter (OM), plant available phosphorus (P) and extractable potassium (K), were obtained from 2001 to 2018. It was assumed that EC, pH, OM, P and K values are indicative of the overall soil fertility status of each district, and for the defined CPZs when aggregated. The farmers of a district may plan nutrient management practices as per the guidelines provided for their respective district. However, farmers are advised to consult with the nearest Soil and Water Testing Laboratories and Agriculture Advisory Services before sowing crop(s).

SUMMARY AND WAY FORWARD

Agriculture is the backbone of Pakistan's economy. Economic development is possible through efficient use and conservation of natural resources, particularly the soil/land (non-renewable) and water. Unfortunately, the misuse of soil has led to loss of soil fertility and health, compelling the Sufficient use of chemical fertilizers that too is not utilized efficiently. The resource base of raw materials for fertilizer production is also depleting fast. These scenarios warrant adoption of best management practices (BMPs) to enhance fertilizer use efficiency and improve soil fertility on a sustainable basis. The Soil Fertility Atlas of the Balochistan Province is a comprehensive document that provides detailed information of cropping patterns, management practices, soil fertility status, trends of fertilizer use, advisory services/facilities available to the farmers in the province and suggests the strategies to maximize productivity while sustaining the soil health and environmental quality.

This Atlas summarize the information of seven distinct Crop Production Zones (CPZs) in Balochistan. Wheat is the most common crop in all the CPZs, but the production does not fulfil the domestic requirements of the growers and is sparingly sold in the market. Apple, apricot, grape and dates are grown in specific zones due to suitable climate for quality fruit production whereas onion, tomato, chillies and cauliflower are grown for markets of Balochistan and other parts of the country during off-seasons. The comparative edge of climate in Balochistan is being exploited by the fruit and vegetable growers. Being the principal cash earning commodities, the above-mentioned fruits and vegetables are grown with mostly balanced supply of the plant nutrients like N, P and K, combined with organic amendments. Size able number of farmers tend to apply N and P together whereas the micronutrient application is not common in fruit orchards. Traditionally, the vegetable growers in the province prefer organic sources because of its availability and low or no cost.

Fertilizer offtake data for ten years (2008-2017) in seven CPZs of Balochistan showed maximum annual urea offtake in CPZ-5 during eight years (2008-15) followed by CPZs 2, 3, 4 and 7, whereas CPZ-1 and 6 exhibited the minimum urea offtake presumably due to infiltration across the borders. The DAP offtake in different CPZs during 2007 to 2017 indicated maximum DAP offtake for CPZ-7 followed by CPZs 4, 5 and 6 that also registered short increase in DAP offtake. It is worth mentioning that CPZ-4 exhibited maximum DAP offtake in the year 2013. However, consistent decrease in the DAP offtake was recorded in the preceding year. The data of the last 10 years (2008-2017) indicated an increasing trend of total K offtake in Balochistan, particularly during the last 3 years (2015-2017). Maximum K offtake was recorded in CPZ-3. Total K offtake for CPZs 2 and 7 remained at minimum during the last decade. In 2013, share of CPZs 2, 3, 5 and 6 in K offtake was comparable. Overall, CPZ-5 has showed a relatively improved offtake of K in comparison to other CPZs in Balochistan.

Being a subsistence crop, wheat yield falls in low to medium productivity range and similar trend was observed for rice. However, few progressive farmers get high rice and cotton yields with balanced use of N, P and organic sources. Wide range of variation in yield of apple, apricot, grape and dates was recorded and the variations are attributed to variable soil types, climate, water availability, fertilizers application and growers' financial conditions. Enhanced investments in nutrient application for both fruits and vegetables in specific areas of CPZs 3, 4, 5 and 6 of the province are related with the handsome cash returns of produce. Introduction of hybrid seeds of vegetables in the afore-mentioned four CPZs is gaining popularity, which requires higher application of nutrients besides balanced use of major elements and micronutrients. Farmers in Balochistan reported nutrient(s) application in eight different combinations (N only; NP; NPK; NP + Micronutrients; NPK + Micronutrients; NP + OA; NPK + Micronutrients + OA; NPK + OA). Moreover, the addition of each nutrient to individual nutrient use scenario was not translated, in general, into the increased yield for the selected crop(s). However, the increased use of nutrients presumably enhanced yield in case of wheat. The same trend is noted in fruits and vegetable crops. Therefore, further investigations are required in the specific CPZ(s) to determine optimum efficient nutrient application for improved crop yield(s).

Water scarcity is the major constraint hampering agricultural activities throughout the province as reported by majority of the farmers (81%), whereas extent of this constraint varies in different zones. Non-availability of good quality seed was also reported by 65% of the farmers whereas access to agricultural loans was limited to 61% farmers. Soil maps to identify soil constraints limiting crop yield in the consistently poor performing areas may be helpful. The spatial distribution of soil constraints at similar scale could also be used to estimate the cost of lost production using soil-constraint matrix. Although crop production on fertile soil with no constraints is preferred obviously, however, due consideration should also be given to marginal lands under the changing climate scenarios.

In summary, first 2Rs, i.e. Right source and Right rate of the desirable 4R Nutrient Stewardship (the Right source at the Right rate at the Right time in the Right place) are

SUMMARY AND WAY FORWARD

usually practiced, but the latter 2Rs are rarely followed by the farming communities that results in low nutrient use efficiency and poor economic returns. This is the first step forward in the right direction and similar activities should be undertaken in other provinces of the country for achieving food security and socioeconomic uplift in the country. For this purpose, a network of soil, plant, water, and fertilizer testing facilities needs to be established for the benefit of farming community. The existing soil and water testing laboratories are not enough to serve approximately one million farmers in Balochistan. At present, not a single soil and water testing laboratory of the private sector is functional even in the economically important CPZs of Balochistan. Outreach linkages with the farmers may be strengthened for extensive surveys/assessments at the farm level and applying BMPs according to the 4R soil constraint based commodity-specific packages. All the partner organizations are encouraged for collaborative efforts to address the adoption of best methodology for nutrient use, and mapping of most responsive crop growth stage(s). Certainly, this effort would contribute towards setting up of a national framework and policy intervention for Agriculture and Natural Resources Management in the Sustainable Development Goals agenda (specifically Crop Production, Environment, and Soil and Water for agriculture related activities). All federal and provincial agencies and the private sector should join hands for collaborative initiatives to achieve sustainable development not only in Balochistan and all over Pakistan.

ACRONYMS

4Rs	Right Source, Right Rate, Rate Time and Right Place
BMPs	Best Management Practices
CPEC	China-Pakistan Economic Corridor
CEWRI	Climate Energy and Water Research Institute
CAN	Calcium Ammonium Nitrate
DAP	Di-Ammonium Phosphate
dS m^{-1}	DeciSiemens per meter
FAO	Food and Agriculture Organization of the United Nations
FAC	Farmer Advisory Center
FFC	Fauji Fertilizer Company Limited
FYM	Farm Yard Manure
GAUL	Global Administrative Unit Layers
GSP	Global Soil Partnership
HEC	Higher Education Commission of Pakistan
ICARDA	International Center for Agricultural Research in the Dry Areas
ISFM	Integrated Soil Fertility Management
ITPS	International Technical Panel on Soils
IUA	Inputs Use Assessment
IUCN	International Union for Conservation of Nature
LRRI	Land Resources Research Institute
NARC	National Agricultural Research Center
NFDC	National Fertilizer Development Center
NIAB	Nuclear Institute for Agriculture and Biology
PCRWR	Pakistan Council of Research in Water Resource
PARC	Pakistan Agricultural Research Council
SDGs	Sustainable Development Goals
USDA	United States Department of Agriculture
USAID	United States Agency for International Development
VGSSM	Voluntary Guidelines for Sustainable Soil Management

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