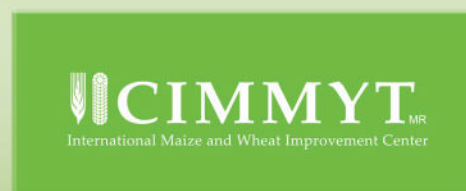


# Nutrient Expert<sup>®</sup> for Wheat:

## USER MANUAL FOR SOUTH ASIA

Version 1.0





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# *Nutrient Expert<sup>®</sup> for Wheat:*

## **USER MANUAL FOR SOUTH ASIA**

Version 1.0

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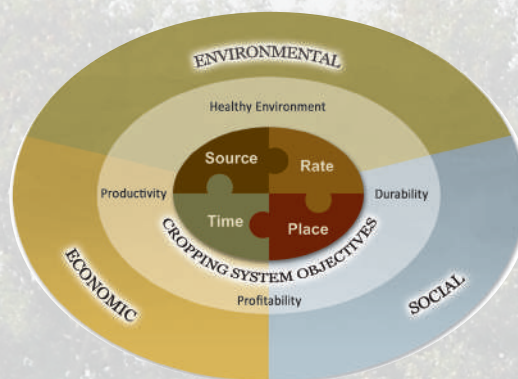
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## **NUTRIENT EXPERT® FOR WHEAT: USER MANUAL FOR SOUTH ASIA – A 4R NUTRIENT STEWARDSHIP RESOURCE**

This manual is consistent with the 4R Nutrient Stewardship concept that defines the right source, rate, time, and place for plant nutrient application as those producing the economic, social, and environmental outcomes desired by all stakeholders to the soil-plant ecosystem.

For more details on 4R Nutrient Stewardship visit [www.ipni.net/4R](http://www.ipni.net/4R)



# Nutrient Expert® for Wheat

**SUGGESTED CITATION:**

Majumdar K, Satyanarayana T, Pampolino M, Dutta S, Jat ML, Sulewski G, and Johnston, AM. 2013. Nutrient Expert® for Wheat (version 1.1). A decision support tool for providing field specific fertilizer recommendations for wheat. International Plant Nutrition Institute, Gurgaon, Haryana, India.

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The International Plant Nutrition Institute (IPNI) and the decision support tool do not endorse or promote specific fertilizers and do not guarantee the accuracy of an analysis labeled on commercial fertilizers. The tool assumes that the N, P<sub>2</sub>O<sub>5</sub>, and K<sub>2</sub>O analysis labeled on a bag of organic or inorganic fertilizer accurately reflects the content of plant nutrients in the fertilizer. In addition to nutrients, many factors (e.g. climate, crop care, water management) affect wheat yield. IPNI and the tool do not guarantee a targeted attainable wheat yield with the provided nutrient management guidelines.

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## ACKNOWLEDGEMENTS

We acknowledge the following organizations for their contribution in the development and/or validation of the Nutrient Expert®:

Cereal Systems Initiative for South Asia (CSISA)

Indian Agricultural Research Institute (IARI), New Delhi

Project Directorate of Farming Systems Research, Modipuram, Uttar Pradesh

University of Agricultural Sciences (UAS), Dharwad, Karnataka

Birsa Agricultural University, Ranchi, Jharkhand

Bihar Agricultural University, Sabour, Bihar

Dr. B. R. Ambedkar University, Agra, Uttar Pradesh

Visva Bharati University, Santiniketan, West Bengal

Department of Agriculture, Government of Bihar

Department of Agriculture, Government of Rajasthan

Department of Agriculture, Government of West Bengal

**Nutrient Expert® for Wheat is a user-friendly nutrient decision support tool that enables researchers, extension experts and industry agronomists to quickly develop field specific fertilizer recommendations for wheat.**

## SYSTEM REQUIREMENTS

*Nutrient Expert® for Wheat* requires about 17 MB of disk space and the following:

- Windows XP or higher
- MS Office 2003 or higher
- MS Access 2003 or higher. In the absence of MS Access application, download the MS Access Runtime from the Microsoft website  
(<http://www.microsoft.com/downloads/details.aspx?familyid=d9ae78d9-9dc6-4b38-9fa6-2c745a175aed&displaylang=en>).
- Acrobat reader 6 or higher (for reading saved outputs as PDF)

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## Chapter 1

### INTRODUCTION

Wheat is the second most important cereal crop next to rice in Asia. Wheat is grown on about 29 M ha in India with an annual production of 86 M t in 2010-11 and an average yield of 2.98 t/ha (FAI, 2012). Recent statistics show that there are considerable yield gaps between the major wheat-growing states in the country with highest yield recorded in Punjab (4.7 t/ha) and lowest in Bihar (1.95 t/ha). In addition, considerable yield gaps exist (Ladha et al., 2003) between researcher-managed optimum NPK plots and farmers' fertilizer practices (FFP), indicating a great opportunity for increasing wheat yield and productivity through improved nutrient management practices.

South Asian agriculture is characterized by small land holdings for cultivation with high variability in plant nutrient availability between fields. However, fertilizer recommendations for crops in this region are usually done over large geographic areas that often fail to meet the overall crop nutrient requirement. Site-specific nutrient management (SSNM), on the other hand, integrates information from different scales to make field specific decisions on N, P and K management. Site-specific nutrient management is a set of nutrient management principles that aims to supply a crop's nutrient requirements tailored to a specific field or growing environment. Its purpose, to (a) account for indigenous nutrient sources, including crop residues and manures; and (b) apply fertilizer at optimal rates and at critical growth stages to meet the deficit between the nutrient needs of a high-yielding crop and the indigenous nutrient supply.

There is little acceptance of SSNM by farmers beyond the on-farm trials. Apart from shortcomings in the strategy to promote SSNM, and farmer's inability to buy fertilizers, extension agents lack confidence in using the methodology (Gabinete and Buresh, 2009). Many extension agents still perceive SSNM as complex, requiring an understanding of concepts and methods outside their experience. Such knowledge requirements have slowed the wide-scale promotion and adoption of SSNM by the farmers and extension agents (Buresh, 2008). The need for more rapid uptake of the SSNM technology by farmers led in the consolidation of SSNM research conducted over the last decade across Asia into a simple delivery system, Nutrient Expert® for Wheat, enabling wheat farmers of the region to rapidly implement SSNM for their individual fields. Nutrient Expert® is a new, computer-based decision support tool that helps crop advisers formulate fertilizer guidelines based on SSNM principles. Nutrient Expert® considers the most important factors affecting nutrient management recommendations in a particular location and enables crop advisers to provide farmers with fertilizer guidelines that are suited to their farming conditions. The tool uses a systematic approach of capturing site information that is important for developing a location-specific recommendation. Yet, Nutrient Expert® does not require a lot of data nor very detailed information as in the case of many sophisticated nutrient decision support tools, which could overwhelm the user. It allows users to draw the required information from their own experience, the farmers' knowledge of the local region, and the farmers' practices. Nutrient Expert® can use experimental data, but it can also estimate the required SSNM parameters using existing site information. Currently, Nutrient Expert® has been applied to wheat for South Asia and China.

The User Manual, while describing various steps involved in operating the tool, will help the user in developing an improved nutrient management practice for attaining better yields of wheat.



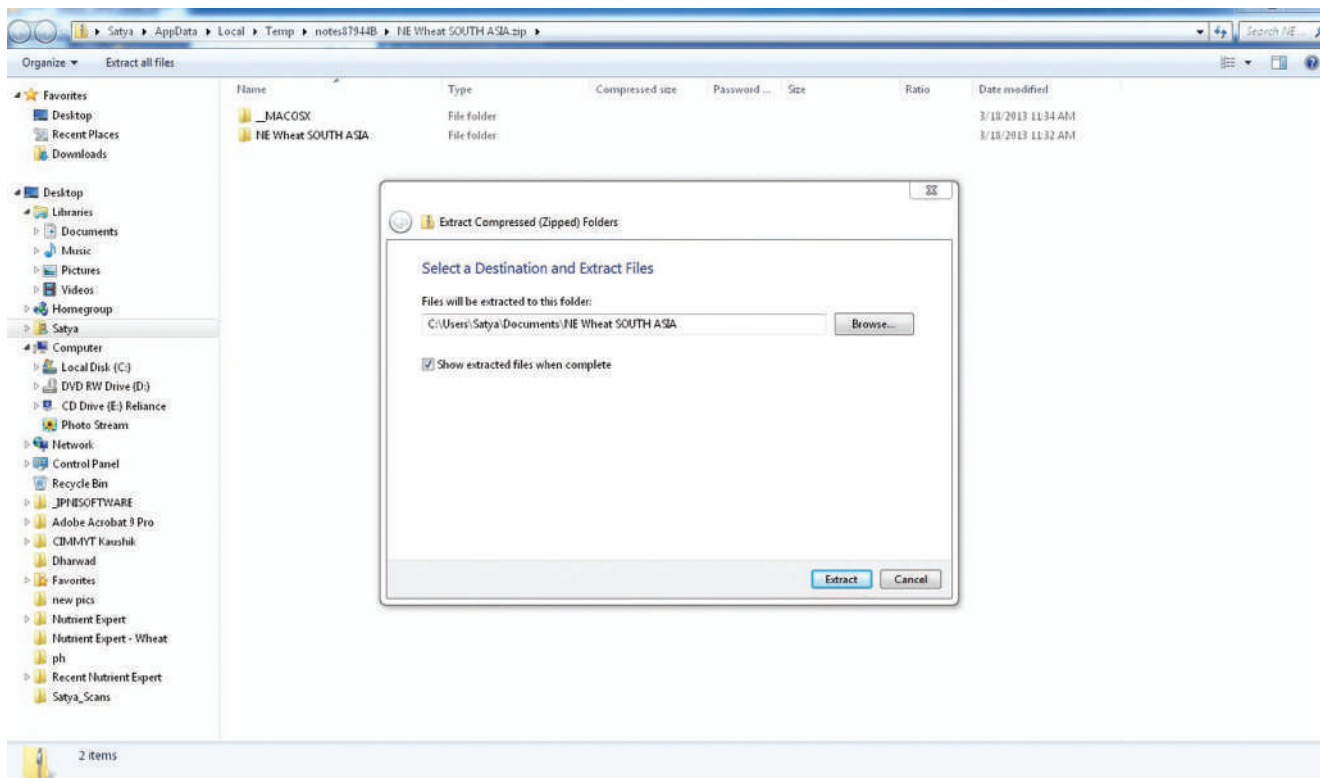
## Chapter 2

### INSTALLATION OF NUTRIENT EXPERT® FOR WHEAT

The *Nutrient Expert® for Wheat* is developed on a MS-Access platform. The package contains an Access based file called “NE Wheat South Asia.mde” along with two supporting programme files named “dynapdf.dll” and “StrStorage.dll”. Downloading the programme to a computer requires that all the three files are stored together in the same folder at an identified location. It is suggested that a single folder in the name of **NE-Wheat** be created at an identified location and all the above mentioned files may be extracted from the external source (Flash Drive/DVD/Website) to the **NE-Wheat** folder.

In the following example (Fig 1), the Nutrient Expert®-Wheat software was downloaded from a zip folder in a flash drive. The three files in the zip folder are then extracted to a new folder “NE-Wheat” created on the desktop.

**FIGURE 1.** Illustration of extracting Nutrient Expert® for Wheat software on to the computer.



## 2.1 ACCESSING THE NUTRIENT EXPERT® FROM COMPUTER

1. Double click the NE-Wheat folder.
2. The following three files will be visible.
  - a) dynapdf.dll, b) NE Wheat South Asia.mde and c) StrStorage.dll
3. Double click the file named “NE Wheat South Asia.mde” keeping the other two supporting programme files undisturbed.
4. The files with .dll extension are required for the “save as PDF” option of the outputs or reports.

## 2.2 WORKING WITH NUTRIENT EXPERT®

On double click at the file named NE Wheat South Asia.mde, a security window opens as follows;



Press the “Open” button to go to the main software page.

## 2.3 ASSUMPTIONS AND CONDITIONS

The guidelines provided by this software assume the following conditions:

- no serious limitation of water (i.e. drought) throughout the growing period
- any problem on acidity and/or micronutrients are properly addressed
- use of high-yielding wheat varieties
- no major damage caused by pests and diseases
- proper placement of fertilizer is practiced

## Chapter 3

### THE “HOME” SECTION



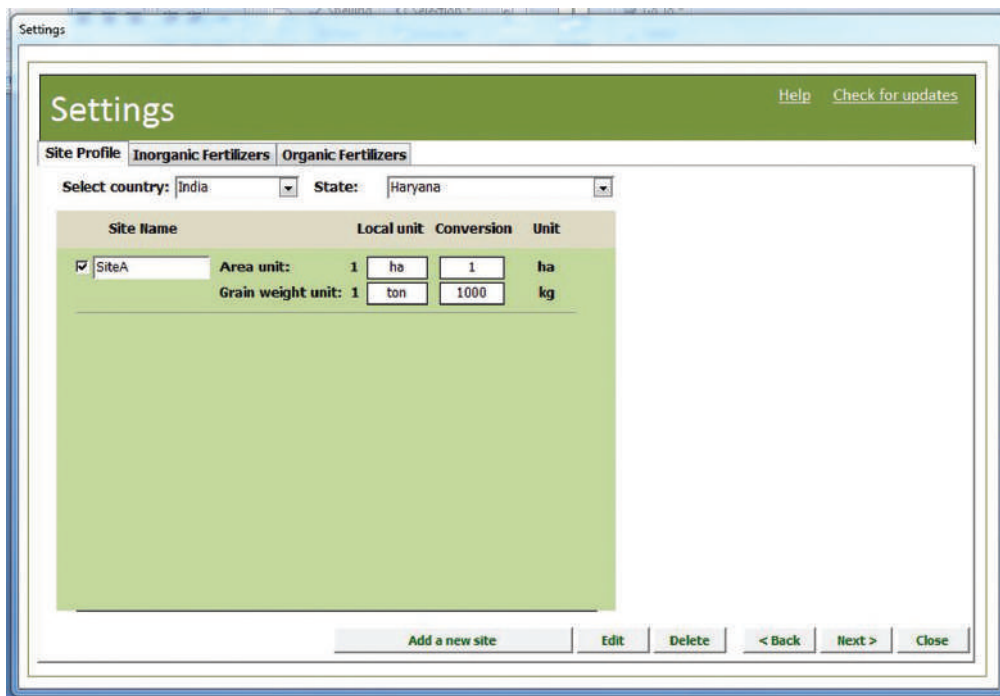
The home page consists of four buttons representing four modules. Each module requires a set of information and provides a report (print or pdf). The user can navigate between modules and make changes, but the user must be aware that changes made in one module may affect other modules because of data sharing. To ensure that all data input have been properly accounted for in formulating the recommendations and profit analysis, the user must go through each of the modules beginning from the first module (Current FFP & Yield) to the last module (Profit Analysis).

In the home page, before developing a nutrient recommendation using the modules, the user needs to customize the software with the country, state, and the season for which the nutrient recommendation is being generated. This is done through the “Settings” button on the top right hand corner of the home page.

#### 3.1 WORKING WITH THE “SETTINGS”

Single click on the “Settings” button opens up a new window (Fig. 2) with three tabs.

FIGURE 2.

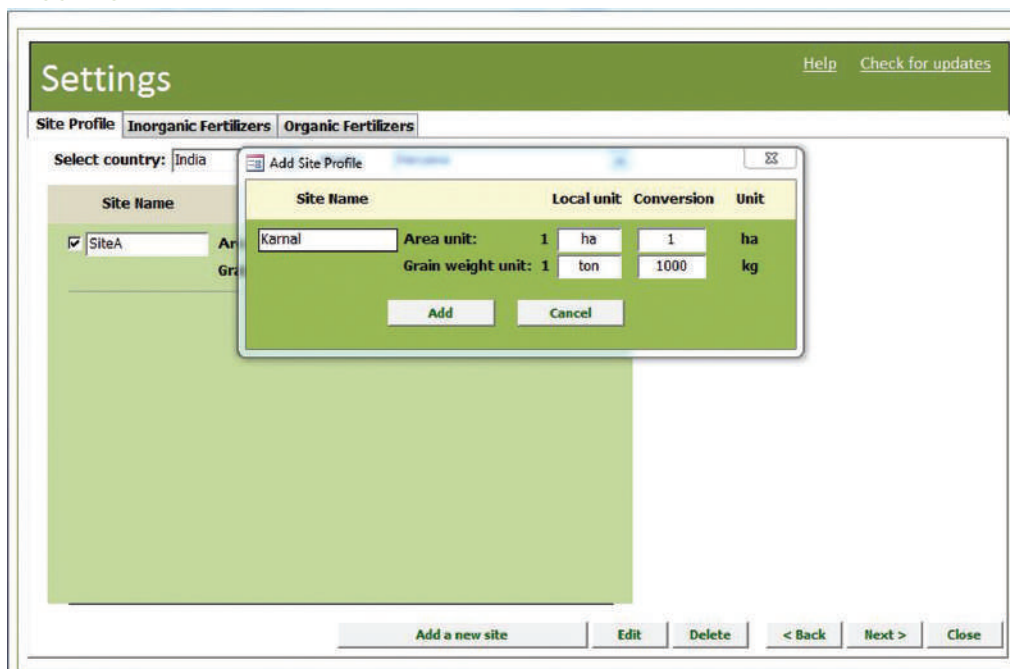


### 3.1.1 “SITE PROFILE”

The first tab on “Site Profile” identifying the country, state, season, preferred unit of area and grain weight of the produce of the farmer for whom the recommendation is being generated.

Within the “Site Profile”, a new Window opens up (Fig. 3) once the location (Country and State) information is selected.

FIGURE 3.



Provide the Site Name (For example Karnal) and press Add. Use the “Edit button” to subsequently change the location for which a new Nutrient Expert® based recommendation is required. The user can also specify the preferred unit for area (e.g. acre) with the equivalent value in hectare (e.g. 1 acre = 0.4 ha). Similarly, the preferred grain weight unit can be specified with the corresponding equivalent in kilogram. If the user did not specify any area or grain weight unit, the default units are hectare for area and ton (1000 kg) for grain weight.

### 3.1.2 “INORGANIC FERTILIZERS”

Pressing the “Inorganic Fertilizers” Tab within the Settings window, opens a new window consisting of a list of most common chemical fertilizer sources with their nutrient contents and the price of a 50 kg bag of the concerned fertilizer. The pop-up list can be edited to include new fertilizer sources, their nutrient content and price (Fig 4) using the “Add new inorganic fertilizer source button”. The “Edit” button at the bottom allows making any changes to the existing fertilizer source in terms of its nutrient content or price.

FIGURE 4.

Fertilizer sources	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O	MgO	CaO	S	Zn	Fe	Cu	Mn	B	Weight of full bag (kg)	Price per bag (INR)
Diammonium Phosphate	18	46	-	-	-	-	-	-	-	-	-	50	468.00
Muriate of Potash	-	-	60	-	-	-	-	-	-	-	-	50	223.00
Urea	46	-	-	-	-	-	-	-	-	-	-	50	242.00
10-26-26	10	26	26	-	-	-	-	-	-	-	-	50	1,150.00
12-32-16	12	32	16	-	-	-	-	-	-	-	-	50	1,232.00
14-28-14	14	28	14	-	-	-	-	-	-	-	-	50	353.00
14-35-14	14	35	14	-	-	-	-	-	-	-	-	50	1,223.00
17-17-17	17	17	17	-	-	-	-	-	-	-	-	50	985.00
19-19-19	19	19	19	-	-	-	-	-	-	-	-	50	325.00
23-23-0	23	23	-	-	-	-	-	-	-	-	-	50	308.00
	-	-	-	-	-	-	-	-	-	-	-	-	0.00

### 3.1.3 “ORGANIC FERTILIZERS”

Pressing the “Organic Fertilizers” Tab within the Settings window, opens a new window (Fig 5) consisting of a list of most common organic sources of nutrients with their nutrient contents and the price of either a tractor load or a cart load of the concerned organic fertilizer source. The pop-up list can be edited to include new organic fertilizer sources, their nutrient content and price using the “Add new organic fertilizer source button”. The user can select either a “Tractor trolley” or a “Cartload” within the option of “select the local unit of the manure/organic”. The weight of the organic fertilizer carried by a tractor trolley or a cartload may be selected from the default values within the option “weight (kg)” or the user may change the default weight based on local knowledge using the “Edit” button. The “Edit” button also allows making any changes to the existing organic fertilizer source in terms of its nutrient content, weight or price.

FIGURE 5.

Settings

Help Check for updates

Site Profile Inorganic Fertilizers **Organic Fertilizers**

Select a local unit for manure/organics: tractor trolley weight (kg): 50

**Nutrient content and price of organic fertilizers**

Fertilizer sources	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O	MgO	CaO	S	Zn	Fe	Cu	Mn	B	Weight of full unit kg	Price per unit (INR)
Castor cake	4.37	1.85	1.39	-	-	-	-	-	-	-	-	50	0.00
Cattle dung	0.35	0.12	0.17	-	-	-	-	-	-	-	-	50	0.00
FYM	0.75	0.2	0.5	-	-	-	-	-	-	-	-	350	0.00
Biogas slurry	1.41	0.72	0.84	-	-	-	-	-	-	-	-	350	0.00
Blood meal	11	1.2	1	-	-	-	-	-	-	-	-	350	0.00
Cotton cake	3.9	1.8	1.6	-	-	-	-	-	-	-	-	350	0.00
Green manure (Dhaincha)	1.50	0.60	1.20	-	-	-	-	-	-	-	-	350	0.00
Linseed cake	5.5	1.4	1.2	-	-	-	-	-	-	-	-	350	0.00
Poultry manure	2.87	2.9	2.35	-	-	-	-	-	-	-	-	350	0.00
Pressmud	2.1	4.4	0.8	-	-	-	-	-	-	-	-	350	0.00

Add new organic fertilizer source Edit Delete < Back next > Close

Use the “Close” button to go back to the “Home Page” once all the required changes are made in the “Settings”.





## Chapter 4

## WORKING WITH THE “CURRENT FFP & YIELD” MODULE IN THE “HOME PAGE”

The Current FFP & Yield module assesses the yield levels achieved by the farmer for a particular location in the given season and the nutrient application rates used to achieve the yield levels.

### INFORMATION REQUIRED

- Yield of winter wheat in the farmers’ field for a typical season under consideration (in the past 3 to 5 years).
- Farmers’ nutrient management practice – amount of fertilizer (inorganic, organic sources); timing of fertilizer application.
- Yield and fertilizer inputs must be provided in field size basis.

### EXPECTED OUTPUT

- Summary table of farmers’ current nutrient management practice (N, P<sub>2</sub>O<sub>5</sub>, K<sub>2</sub>O and other secondary and micronutrients). Nutrient rates per application are given in kg/ha basis.
- Total amount of applied N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O separately for inorganic and organic sources.

This information is provided on a hectare basis.

Provide the farmer “Name and/or location” (Village/Block/Mandal) and the actual “Field Size” at the provided space on the top of the page (Fig 6). The input for the actual field size must be in the unit specified in Settings as shown in Fig. 6. For example, if the field size is 1.0 acre, the user should write in the box next to “Field size” as 0.4 and the area will be automatically calculated on a hectare basis. If the user did not specify any area unit in the Settings, only hectare (ha) will appear under “Field size.” In that case, a field of 1.0 acre should be written as 0.4 ha.

FIGURE 6.

### 4.1 CURRENT FARMERS’ YIELD

Question 1 in this module asks the farmer about the average wheat yield for the specified field over the past 3 to 5 years. Yields in abnormally good or bad seasons should be ignored while providing the input. Wheat yield for the specified field is then converted to a hectare basis considering the moisture

content at harvest (Fig 7). Often, the farmers do not know the moisture content and therefore a default value of 13.5% is used in such cases. However, the moisture content, if known, could be provided in the appropriate input box in the module for use in the yield calculation.

FIGURE 7.

**Nutrient Expert for Wheat** Home Settings Help

**Current FFP and Yield** | SSNM Rates | Sources and Splitting | Profit Analysis

Name and/or location:   Field size:  ha

1. What is the yield of winter wheat for a typical season in the past 3 to 5 years?  
Provide total amount of harvested grain from the entire field.  
Total harvested grain (1000 kg/ton):  ton  
Moisture content (if known):  %  
Yield at 13.5% moisture:  t/ha

## 4.2 FARMERS' FERTILIZATION PRACTICE

The second question in this module assesses the rate and source of nutrient used by the farmer for achieving the above specified wheat yield. The inputs are divided into inorganic and organic fertilizer sources and the farmer provides the information on the basis of the actual field size (Fig 8).

FIGURE 8.

**Nutrient Expert for Wheat** Home Settings Help

**Current FFP and Yield** | **SSNM Rates** | Sources and Splitting | Profit Analysis

Name and/or location:   Field size:  ha

2. How much fertilizer does the farmer usually apply to the entire wheat field?  
Click the fertilizer type to see list of fertilizer materials and enter amount.

Inorganic fertilizers       Organic fertilizers

N:  kg/ha      N:  kg/ha  
P<sub>2</sub>O<sub>5</sub>:  kg/ha      P<sub>2</sub>O<sub>5</sub>:  kg/ha  
K<sub>2</sub>O:  kg/ha      K<sub>2</sub>O:  kg/ha

Others: kg/ha  
B:  Cu:  Fe:  MgO:   
Mn:  S:  Zn:

**Inorganic fertilizers** 88

Field size:  ha

How many times does the farmer apply fertilizer during the season?  
 1 time    2 times    3 times    4 times

Application no.	Days after sowing	Fertilizer	Weight of full bag (kg)	No. of bags
1	0	Diammonium Phosphate	50	1.00
		Muriate of Potash	50	0.20
		Zinc Sulphate	10	1
2	21	Urea	50	1.00
3	45	Urea	50	1.00

- Pressing the “**Inorganic fertilizers**” button opens a new window to provide the inputs for amount and time of fertilizer application.
- First, choose the “**number of times**” fertilizer is applied by the farmer by clicking on the appropriate circle (1 time / 2 times / 3 times / 4 times).
- Based on the selection, the options for adding fertilizer sources appear at the bottom of the window.
- Provide the time of application at the space provided under “**Days after sowing**” option. For example, fertilizer applied as basal would mean an input of “0” to be written under “**Days after sowing**”.
- Use the tab button on the keypad of your computer (or move the mouse cursor) to go to the “**Fertilizer Sources**” and type the name of the fertilizer source used by the farmer.
- Use the tab button again to go to the option “**No. of bags**” and write how many bags of the specified fertilizer source was used by the farmer at that time of application for the entire field. For example, a farmer applying 50 kg DAP and 10 kg MOP as basal would consider an input of 1 bag of DAP and 0.2 bag of MOP.
- Follow the same procedure to provide inputs when fertilizer is applied more than once during the crop growth period. For example, when fertilizer is applied three times during the crop growth period, information for “**Days after sowing**”, “**Fertilizer Sources**” and “**No. of bags**” must be provided for each application time (Fig. 8). Press the “**OK**” button once all inputs are provided.
- If the user wishes to account for secondary and micronutrients application, then appropriate secondary and micronutrient sources used by the farmer must be added to the list of “**Inorganic Fertilizer**” through the “**Settings**” option. This will allow choice of these sources while answering Question 2 in the “**Current FFP and Yield**” Module. The summary of secondary and micronutrients application rates will show up in the “**Current NM Practice**” Module in kg/ha (Fig. 10).
- With this, the fertilizer sources and rates applied at different times of application would transform to the actual N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O rates on a hectare basis, irrespective of the farm size considered for providing inputs, and would appear under the “**Inorganic fertilizers**” section of the “**Current FFP and Yield**” module.

Press the “**Organic Fertilizers**” button to open another window to provide the source and the amount of organic fertilizer applied by the farmer in his field (Fig 9).

Select the “**Fertilizer**” applied from the drop down menu and specify the weight of the full unit (tractor trolley/cartload) and the number of units applied in the concerned field.

- Click the OK button once the inputs are provided.
- With this, the organic fertilizer sources and rates applied would transform to the actual N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O rates on a hectare basis, irrespective of the farm size considered for providing inputs, and would appear under the “**Organic fertilizers**” section of the “**Current FFP and Yield**” module.

FIGURE 9.

**Nutrient Expert for Wheat** Home Settings Help

Current FFP and Yield **SSIM Rates** Sources and Splitting Profit Analysis

Name and/or location: Vikas Kumar, Taraori Karnal; Haryana

- What is the yield of winter wheat for a typical season in the past 3 to 5 years?  
Provide total amount of harvested grain from the entire field.  
Total harvested grain (1000 kg/ton): 2.2 ton  
Moisture content (if known): %  
Yield at 13.5% moisture: 5.5 t/ha
- How much fertilizer does the farmer usually apply to the entire wheat field?  
Click the fertilizer type to see list of fertilizer materials and enter amount.

Inorganic fertilizers		Organic fertilizers	
N:	137.5 kg/ha	N:	0 kg/ha
P <sub>2</sub> O <sub>5</sub> :	57.5 kg/ha	P <sub>2</sub> O <sub>5</sub> :	0 kg/ha
K <sub>2</sub> O:	15 kg/ha	K <sub>2</sub> O:	0 kg/ha

Others: kg/ha  
 B: 0 Cu: 0 Fe: 0 MgO: 0  
 Mn: 0 S: 3.75 Zn: 5.25

Report Reset < Back Next > Close

**Organic Fertilizer**

Field size: 0.4 ha

Fertilizer	Weight of full unit (kg)	Number of units
FYM	350	2
	0	0

OK Clear Clear All Cancel

Once all inputs are provided, the “Current FFP and Yield” will show the amount of N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O applied to the particular field along with applied secondary and micronutrients if any, the fertilizer sources as well as the time of application (Fig 10).



FIGURE 10.

[Home](#)   [Settings](#)   [Help](#)

## Nutrient Expert for Wheat

**Current FFP and Yield**   SSNM Rates   Sources and Splitting   Profit Analysis

Name and/or location:   Field size:  ha

1. What is the yield of winter wheat for a typical season in the past 3 to 5 years?  
Provide total amount of harvested grain from the entire field.

Total harvested grain (1000 kg/ton):  ton  
Moisture content (if known):  %  
Yield at 13.5% moisture:  t/ha

2. How much fertilizer does the farmer usually apply to the entire wheat field?  
Click the fertilizer type to see list of fertilizer materials and enter amount.

Inorganic fertilizers

N:  kg/ha  
P<sub>2</sub>O<sub>5</sub>:  kg/ha  
K<sub>2</sub>O:  kg/ha

Organic fertilizers

N:  kg/ha  
P<sub>2</sub>O<sub>5</sub>:  kg/ha  
K<sub>2</sub>O:  kg/ha

**Others: kg/ha**

B:    Cu:    Fe:    MgO:   
Mn:    S:    Zn:

**1<sup>st</sup> application at 0 DAS**

Source	No. of bags	N —kg/ha—	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O
Diammonium Phosphate	1	22.5	57.5	0
Muriate of Potash	0.2	0	0	15
Zinc Sulphate	1	0	0	0

**2<sup>nd</sup> application at 21 DAS**

Source	No. of bags	N —kg/ha—	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O
Urea	1	57.5	0	0

**3<sup>rd</sup> application at 45 DAS**

Source	No. of bags	N —kg/ha—	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O
Urea	1	57.5	0	0

The report of the output of the “Current FFP and Yield” module could be saved as a pdf file or may be printed by pressing the “Report” button at the left bottom corner of the screen.

The entire information provided in this module may be cleared using the “Reset” button on the left bottom corner of the module for adding fresh inputs to the questions.

The “<Back” and “Next>” buttons at the bottom right hand corner helps to navigate to the previous or to the next module respectively. The user may also navigate through the modules by clicking on the module tabs at the upper part of the page. Pressing the “close” button will take the user back to the home section.

**Note:** The utility of all the five buttons given in the bottom of each module remain same across the modules.

Farmers’ yield will be used as (a) the basis for suggesting a yield goal and (b) for estimating benefits in the “Profit Analysis” module; while farmers’ fertilizer practice will be used for estimating costs in the “Profit Analysis” module.

Press the “Next” button to go to the “SSNM Rates” module.



## Chapter 5



## WORKING WITH THE “SSNM RATES” MODULE

This module uses the attainable yield target, calculates the nutrient balance in the cropping system considering the external nutrient inputs and combines that with the expected N, P and K responses in the concerned farmer’s field to provide nutrient recommendations for achieving the attainable yields.

### INFORMATION REQUIRED

- Estimate of the attainable yield (if known).
  - Alternatively, characteristics of the growing environment (irrigated/rainfed, risks of flooding and/or drought, presence of soil related constraints other than NPK) are used to estimate the attainable yield.
- Estimates of yield responses to fertilizer N, P and K (if known).
  - Alternatively soil fertility indicators such as soil texture and colour, historical use of organic inputs, and information related to previous crop (yield, fertilizer inputs, crop residue management) will be used by the software to estimate yield responses.
- Crop residue management, use of organic inputs, and nutrient carry over from previous crop are used to adjust fertilizer P and K requirements as merited.

### EXPECTED OUTPUT

- N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O requirements along with other secondary and micronutrient recommendations for the estimated attainable yield and yield responses to fertilizer.
- Nutrient credits or adjustments (as merited).

### 5.1 ATTAINABLE YIELD OF A LOCATION

Provide the attainable yield of a location in **Question 1** if it is already known. Attainable yield is explained as the yield obtained in a well-managed research plot with minimum constraints for a typical climatic condition.

If the attainable yield is not known, the user can press the “?” mark next to question 1 that opens a new window shown in figure 11. This new window takes the user through a series of questions related to the growing environment to indirectly estimate the attainable yield of the location.

FIGURE 11.

**Nutrient Expert for Wheat**

Current FFP and Yield | SSNM Rates | Sources and Splitting | Profit Analy

Name and/or location: Vikas Kumar, Taraori; Karnal; Haryana

Fertilizer N, P, and K requirements are based on yield goal (i.e. attainable yield) of \_\_\_\_\_ t/ha

1. What is the attainable yield for your location? ? t/ha

2. What does the farmer do with wheat residues after harvest?

Remove all the above ground residues from the field  Retain 20% of aboveground residue on the surface

3. Will the farmer apply organic fertilizers (e.g. manure)?  Yes  No

4. Determine residual benefit from your previous crop?  Yes  No

5. Any results from omission plot trials conducted in a similar field in the past?  Yes  No

6. Account for nutrient credits?  Yes  No

N response (t/ha)	Fertilizer N (kg/ha)
1.0	80
1.5	95
2.0	110
2.5	125
3.0	140
3.5	155
4.0	170
4.5	185
5.0	200

N response: \_\_\_\_\_ t/ha P response: \_\_\_\_\_ t/ha

Final N rate: \_\_\_\_\_ kg N/ha Final P rate: \_\_\_\_\_ kg P<sub>2</sub>O<sub>5</sub>/ha Final K rate: \_\_\_\_\_ kg K<sub>2</sub>O/ha

Report Reset < Back Next > Close

---

**Estimate attainable yield**

Name and/or location: Vikas Kumar, Taraori; Karnal; Haryana Wheat crop: winter

Farmer's Yield: 2.2 ton (13.5% MC) 5.5 t/ha (13.5% MC)

Describe the growing environment:

1. Water availability (source of water):  irrigated  fully rainfed  rainfed with supplemental irrigation

1.a. Do you have an estimate of the K input from irrigation water?  Yes  No 15 kg K<sub>2</sub>O/ha/crop

2. Low temperature or frost incidence:  often  seldom  never  
[often = 2 or 3 out of 5 times; seldom = 1 out of 5 times]

3. Drought problems:  often  seldom  never  
[often = 2 or 3 out of 5 times; seldom = 1 out of 5 times]

4. Soil-related problems other than NPK:

acidity

deficiency of secondary nutrients and micronutrients:

boron  copper  iron  magnesium  manganese  molybdenum  sulfur  zinc

problem soils:

saline soils  alkal soils  sloping land (10% slope or higher)  degraded soils

none

Estimate The attainable yield for your location is: 7 t/ha (13.5% MC); Growing environment: Irrigated

OK Reset Cancel

The questions in the new window describes the growing environment.

- Water availability: Choose one of the three options that best describes the farmer's access to water (irrigated/fully rainfed/rainfed with supplemental irrigation).
  - Pressing "irrigated" as the water availability option will prompt the user to give an estimate of K input from irrigation water. If the user has information on K input from irrigation water, then press "Yes" and provide corresponding values in kg K<sub>2</sub>O/ha/crop else press "No" so that the software takes a default value of 15 kg K<sub>2</sub>O/ha/crop.
- Low temperature or frost incidence problems: Choose one of the three options (often/seldom/never) based on the intensity of occurrence of such problems, where.
  - "often" means prevalence of low temperature/frost in 2 or 3 years out of 5 years.
  - "seldom" represents occurrence of low temperature/frost in 1 out of 5 years.
  - Choose "never" when there is no incidence of low temperature/frost.
- Drought problems: Choose one of the three options (often/seldom/never), where.
  - "often" means occurrence of drought in 2 or 3 years out of 5 years.
  - "seldom" represents occurrence of drought in 1 out of 5 years.
  - Choose "never" when there is no possibility of drought.
- Soil-related problems other than NPK:
  - Acidity:** Choose this option when the pH is below 5.3 and the selection of this option will ask the user to provide the pH value of the soil and if required, the software will suggest the lime requirement in the final recommendation report based on the level of soil acidity.
  - Deficiency of secondary and micronutrients:** Secondary and micronutrient deficiency in the soil can adversely impact the yield of wheat. Upon flagging such deficiencies, the software will recommend appropriate rate and source of application of secondary and micronutrients based on the current state recommendation, which will be included in the final report.
  - Problem soils:** Identifying the farmers' fields as acid sulfate soils, degraded soils or saline soil will be considered as a major constraint towards achieving high yields and thus limits the attainable yield to certain extent.



- Choose “none” if there is no soil-related problems other than NPK.
- Press the “Estimate” button on the bottom left hand corner to estimate the attainable yield under the above constraint levels.
- Press “OK” to go back to the “SSNM Rates” module.

## 5.2 MANAGING RESIDUES IN THE CURRENT WHEAT CROP

A large amount of soil nutrients are removed from the field along with crop residues during harvest. This is particularly true for cereals like wheat, which also produces a substantial amount of non-grain biomass. It was estimated that about 1.6 kg of P and 16 kg K are accumulated in the wheat straw for each tonne of grain yield. Generally, wheat straw is removed from the field along with the harvested grain, causing extensive mining of nutrients from the soil. Recycling residues back to the field after harvest of the crop will stop such export of nutrients that can later be utilized by the succeeding crop. Such contribution of nutrients from the residues needs to be taken into account while formulating nutrient management strategies for wheat.

Farmers adopt different options of residue management although most farmers remove residues from their fields. The Nutrient Expert® tries to capture the extent of nutrients recycled through residues under **different options of residue management in Question 2 in the “SSNM Rates” module**. This information is used to estimate the nutrient balance in a specified field. Therefore, it is important for the user to understand and select the right residue management option while developing the SSNM rates for a particular field.

Choose one among the following options to capture the residue management practice adopted by the farmer for the current wheat crop.

- **Remove all the above ground residues from the field:** Choose this option if all the above ground biomass is completely removed from the field along with the harvested product.
- **Retain 20% of above ground residue and incorporate:** Select this option when the above ground biomass is retained to an extent of 20% or above and is incorporated in the soil.
- **Retain 20% of above ground residue on the surface:** After harvest of wheat, when the straw was retained in the field to an extent of 20% or above and the anchored residues/stubbles were retained in the field.
- **Retain 20% of above ground residue and burn:** When the above ground biomass is left in the field to an extent of 20% or above and is burnt before planting of the next crop.

## 5.3 NUTRIENT CREDITS FROM ORGANIC INPUTS

Organic sources of nutrients, in addition to improving the physico-chemical and biological properties of soil, contribute to the nutrient requirement of the wheat crop when added in ample quantities. Therefore it is important to capture such information in order to consider the nutrient contribution from such sources and accordingly give credits both in the nutrient balance and fertilizer recommendation calculations.

In **Question 3** of the **SSNM Rates** module, the user is asked whether the farmer will apply any organic manure to the current wheat crop.

Press “Yes” if the farmer plans to apply organic manure to the current wheat crop. Pressing “Yes” will open a new window which allows the user to provide the type (“Fertilizer source”) and quantity (“Weight and Number of units”) of manure to be used by the farmer (Fig 12). The Nutrient Expert® calculates the contribution of N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O from such addition and includes that in the nutrient rate calculation of the SSNM rate module.

Press “No” if the farmer does not plan to apply any organic manure in the current wheat crop.

FIGURE 12.

The screenshot shows the 'Nutrient Expert for Wheat' software interface. The main window has tabs for 'Current FFP and Yield', 'SSNM Rates', 'Sources and Splitting', and 'Profit Analysis'. The 'SSNM Rates' tab is active. The user has entered 'Vikas Kumar, Taraori; Karnal; Haryana' for the location and '0.4 ha' for the field size. The software asks for the attainable yield (7 t/ha) and how wheat residues are handled. A dialog box titled 'Organic fertilizer' is open, showing a table for fertilizer application:

Fertilizer	Weight of full unit (kg)	Number of units
FYM	350	3
Urban compost	350	3
	0	0

The dialog box also includes 'OK', 'Clear', 'Clear All', and 'Cancel' buttons. Below the dialog box, the main window shows 'Final N rate', 'Final P rate', and 'Final K rate' fields, along with 'Report', 'Reset', '< Back', 'Next >', and 'Close' buttons.

## 5.4 NUTRIENT CARRYOVER FROM PREVIOUS CROP

This section deals with the residual benefit from the nutrient application in the previous crop. Nutrients applied to a crop may remain unutilized due to lesser uptake while in some cases nutrient application may become inadequate and crop uptake may deplete soil nutrient reserves. In situations where nutrient is applied in excess of requirement (particularly P and K), it can become available to the next crop and should be taken into account while assessing the nutrient requirement of the succeeding crop. Similarly, inadequate nutrient application in the previous crop should be accounted for in the succeeding crop as a negative balance to stop unwanted exhaustion of indigenous nutrients by the crop.

Wheat may be grown in sequence with several crops namely rice, maize, cotton, sugarcane, pearl millet, sorghum etc. Nutrient Expert® estimates the balance of nutrients applied in the preceding crop and combines it with the nutrient balance for the current crop to determine excess amounts of nutrients that could be deducted from the total nutrient requirement.

Press “Yes” in Question 4 of the “SSNM Rates” module if the user wishes to account for the residual benefit from nutrients applied in the previous crop.

Pressing “Yes” will open a new window and the user will be asked to select a crop that was grown in the same field prior to the current wheat crop (Fig. 13).

The user will need to choose a single crop from the provided options in question 1 of the newly opened window: Rice/Maize/Other Crop (Sugarcane, Cotton, Pearl millet, Soybean).

FIGURE 13.

**Nutrient Expert for Wheat**

Current FFP and Yield | SSIM Rates | Sources and Splitting | Profit Analysis

Name and/or location: Vikas Kumar, Taraori; Karnal; Haryana

Fertilizer N, P, and K requirements are based on yield goal (i.e. attainable yield) of  t/ha

1. What is the attainable yield for your location?  t/ha

2. What does the farmer do with wheat residues after harvest?

Remove all the above ground residues from the field  Retain 20% of aboveground residue on the surface

Retain 20% of aboveground residue on the surface  Retain 20% of aboveground residue in the field

3. Will the farmer apply organic fertilizers (e.g. manure)?  Yes  No

4. Determine residual benefit from your previous crop?  Yes  No

5. Any results from omission plot trials conducted in a similar field in the location?  Yes  No

6. Account for nutrient credits?  Yes  No

N response (t/ha)	Fertilizer N (kg/ha)
1.0	80
1.5	95
2.0	110
2.5	125
3.0	140
3.5	155
4.0	170
4.5	185
5.0	200

Yield (t/ha)	6.5	7	7.5
P response (t/ha)			
Fertilizer P, O <sub>2</sub> (kg/ha)			

Final N rate:  kg N/ha      Final P rate:  kg P<sub>2</sub>O<sub>5</sub>/ha      Final K rate:  kg K<sub>2</sub>O/ha

Report    Reset    < Back    Next >    Close

**Previous crop and management**

**Previous crop and management**

1. What crop was grown on the same field in the previous season?

maize  rice  other crop (select from list)

1a. Tillage practice:  zero till  reduced till  conventional till

1b. Water availability (source of water):  irrigated  fully rainfed  rainfed with supplemental irrigation

1c. Do you have an estimate of the K input from irrigation water?  Yes  No  kg K<sub>2</sub>O/ha/crop

2. What was the yield of rice in the previous season? Provide total amount of harvested paddy from the entire field.

Total harvested grain (1000 kg/ton):  ton      Moisture content (if known):  %

Yield at 14% moisture:  t/ha

3. What did the farmer do with the rice residue in the previous season?

removed all above ground residue from the field  retained stubble and removed straw from the field

retained all above ground residue on the surface  retained stubble and burned straw

retained all above ground residue in the field and burned  retained stubble, burned straw and incorporated

4. How much fertilizer was applied to the previous crop?

**Inorganic fertilizers**      **Organic fertilizers**

N:  kg/ha      N:  kg/ha

P<sub>2</sub>O<sub>5</sub>:  kg/ha      P<sub>2</sub>O<sub>5</sub>:  kg/ha

K<sub>2</sub>O:  kg/ha      K<sub>2</sub>O:  kg/ha

OK    Reset    Cancel

In **Question 1a**, choose one of the three options of tillage practice (zero till/reduced till/conventional till) followed in the previous crop.

In **Question 1b**, choose one of the three options that best describes the farmer's access to water (irrigated/fully rainfed/rainfed with supplemental irrigation). Selecting "irrigated" as the water availability option will prompt the user to give an estimate of K input from irrigation water in **Question 1c**. If the user has information on K input from irrigation water, then press "Yes" and provide corresponding values in kg K<sub>2</sub>O/ha/crop else press "No" so that the software takes a default value of 75 kg K<sub>2</sub>O/ha/crop (Fig 13).

In **Question 2** in the new window (Fig 13), provide the yield of the crop grown in the previous season. The yield could be provided for the field size chosen in the "Current FFP and Yield" module, which will then be converted to t ha<sup>-1</sup> by Nutrient Expert®. The user may provide the moisture content of the produce at the time of harvest or a default value will be used by the tool to calculate the final yield.

Farmer's practices of handling the residues of the previous crop are captured in **Question 3** of the new window.

For "rice" as previous crop (Fig 13), choose one among the following options to capture the residue management practice adopted by the farmer.

- **Removed all above ground residues from the field:** Choose this option if all the above ground biomass is completely removed from the field along with the harvested produce.
- **Retained all above ground residues on the surface:** Select this option when all the above ground biomass is retained on the soil surface after harvest of the crop.
- **Retained all above ground residues in the field and burned:** When the above ground biomass is left in the field after harvest and is burnt before planting of the next crop.
- **Retained stubble and removed straw from the field:** When the above ground biomass is removed leaving only the stubbles in the field.
- **Retained stubble and burned straw:** When the rice straw is burnt in the field leaving only the anchored stubbles of the rice plants.
- **Retained stubble, burned straw and incorporated:** When the rice straw is burnt in the field and anchored stubbles, along with the leftover ash, are incorporated in the field.

The options in Question 3 may vary with the chosen previous crop. In case of maize, choose one among the five options given in Figure 14.

FIGURE 14.

Previous crop and management

**Previous crop and management**

1. What crop was grown on the same field in the previous season?  
 maize  rice  other crop (select from list)

1a. Tillage practice:  zero till  reduced till  conventional till

1b. Water availability (source of water):  irrigated  fully rainfed  rainfed with supplemental irrigation

2. What was the yield of maize in the previous season? Provide total amount of harvested grain from the entire field.  
 Total harvested grain (1000 kg/ton):  ton      Moisture content (if known):  %  
 Yield at 15.5% moisture:  t/ha

3. What did the farmer do with the maize residues in the previous season?  
 removed all above ground residue from the field       retained all stover in the field for incorporation to next crop  
 retained 50% of stover for incorporation to next crop       retained all stover in the field and burned  
 retained 50% of stover in the field and burned

4. How much fertilizer was applied to the previous crop?      **maize**

**Inorganic fertilizers**      **Organic fertilizers**

N:  0 kg/ha      N:  0 kg/ha  
 P<sub>2</sub>O<sub>5</sub>:  0 kg/ha      P<sub>2</sub>O<sub>5</sub>:  0 kg/ha  
 K<sub>2</sub>O:  0 kg/ha      K<sub>2</sub>O:  0 kg/ha

OK      Reset      Cancel

Similarly, when the previous crop is other than rice or maize, the user needs to select “other crop (select from list)” option and choose one among the four crops given in the drop down menu. Choice of a crop from the “other crop (select from list)” menu provides the following two options of residue management in Question 3:

- Removed all the above ground residues from the field
- Retained crop residues for incorporation to next crop

Choose one of the appropriate option and proceed to Question 4.

Question 4 (Fig 13) in the “Previous crop and management” window captures the amount of inorganic and organic fertilizers applied in the previous crop. However, the residual benefit of P and K application is only taken into account by the system while the N fertilizer benefit is not considered due to the inherent low N fertility status of soils of the sub-continent that rarely shows any positive residual benefit from N application in previous crop.

Press “Inorganic fertilizer” or “Organic fertilizer” tabs to open new windows to provide the appropriate type and amount of fertilizers applied to the previous crop as described earlier in “Current FFP and Yield” module (Fig 15).

Press “Inorganic fertilizer” or “Organic fertilizer” tabs to open new windows to provide the appropriate type and amount of fertilizers applied to the previous crop as described earlier in “Current FFP and Yield” module (Fig 15).

Press “OK” to go back to the “SSNM Rates” module page once all the inputs are given in the “Previous crop and management” window.

FIGURE 15.

Previous crop and management

**Previous crop and management**

1. What crop was grown on the same field in the previous season?  
 maize  rice  other crop (select from list)

1a. Tillage practice:  zero till  reduced till  full till

1b. Water availability (source of water):  irrigated  rainfed

1c. Do you have an estimate of the K input from irrigation water?  Yes  No

2. What was the yield of rice in the previous season? Provide the following information:  
 Total harvested grain (1000 kg/ton):  ton  
 Yield at 14% moisture:  t/ha

3. What did the farmer do with the rice residue in the previous season?  
 removed all above ground residue from the field  
 retained all above ground residue on the surface  
 retained all above ground residue in the field and buried

4. How much fertilizer was applied to the previous crop?  
 Inorganic fertilizers  Organic fertilizers

N:  kg/ha      N:  kg/ha  
 P<sub>2</sub>O<sub>5</sub>:  kg/ha      P<sub>2</sub>O<sub>5</sub>:  kg/ha  
 K<sub>2</sub>O:  kg/ha      K<sub>2</sub>O:  kg/ha

Past fertilizer used

**Past inorganic fertilizer**

Field size:  ha

Fertilizer	Weight of full bag (kg)	Number of bags
Diammonium Phosphate	<input type="text" value="50"/>	<input type="text" value="1"/>
Urea	<input type="text" value="50"/>	<input type="text" value="2"/>
Muriate of Potash	<input type="text" value="50"/>	<input type="text" value="0.5"/>
	<input type="text" value="0"/>	<input type="text" value="0"/>

OK Clear Clear All Cancel

OK Reset Cancel

## 5.5 ESTIMATING EXPECTED N, P AND K RESPONSE IN THE FARMER'S FIELD

SSNM rates for a particular farmer's field largely depend on the expected crop response to N, P and K fertilizer application. This could be ascertained from the nutrient omission plot results obtained in the particular field or a similar field in the vicinity of the farmer's plot for which SSNM rates for wheat is being developed.

Press "Yes" and provide the N, P and K response values in the appropriate boxes in Question 5 of "SSNM Rates" module if the user has access to nutrient response information from an omission plot trial conducted in the same field or a nearby field with similar growing environment.

Nutrient Expert® is capable of estimating nutrient response for the field under study in situations where nutrient omission plot trials were not conducted in that particular area.

Press "No" in Question 5 of "SSNM Rates" module if nutrient response information from omission plots trial is unavailable. This will open a new window (Fig 16) with a series of questions on the growing environment that enables the user to estimate the expected N, P and K response in the particular field for which the SSNM recommendation is generated.

FIGURE 16.

Estimate yield responses to fertilizer N, P, and K

**Estimate yield responses to fertilizer N, P, and K**

Name and/or location:  Attainable yield:  t/ha (13.5% MC)

Growing environment:

In the absence of omission plot results, we use general soil characteristics and nutrient balance to estimate yield responses. Please note that the estimated responses are subject to verification and fine tuning (e.g. through farmer participatory evaluation).

1. Soil texture:  light  medium  heavy

2. Soil color and organic matter content:  reddish or yellowish  grayish or brownish  very dark soil with high organic matter

3. Has the soil in this field been analyzed for P and K in the past 3–5 years?  yes  no

4. Is your soil known to be P-fixing?  yes  no

The estimated yield responses (at 13.5% MC) are:

N response:  t/ha P response:  t/ha K response:  t/ha

### 5.5.1 SOIL TYPE

Question 1 in the newly opened window (Fig. 16) requires the information on soil texture. Choose one of the three given options (light/medium/heavy) based on the existing soil texture in the farmer's field.

Soil texture is an important soil characteristic that drives crop production and field management. Of the three soil types given in Question 1, the sandy soils tend to be low in organic matter and native fertility, and usually require higher amounts of fertilizer than clayey and loamy soils to achieve a desired yield goal. Whereas, clayey or loamy soils are generally more fertile than sandy soils, contain more organic matter and are better able to retain moisture and nutrients. Therefore, Nutrient Expert® uses the soil type information as an important input towards estimation of nutrient responses in a particular farmer's field.

A sandy soil feels rough and breaks easily if formed into a ball when moist. A loamy soil feels somewhat rough, but holds its shape if formed into a ball when moist. A clayey soil feels sticky between fingers when moist. Use the feel method and visual appearance to closely determine the soil texture of the farmer's field and choose one of the three options, "clayey", "loamy" or "sandy".

### 5.5.2 SOIL COLOR AND ORGANIC MATTER CONTENT

Colour can be a useful indicator of some of the general properties of a soil, including soil fertility. Soil colour is usually determined by the amount and state of organic matter as well as the amount and state of iron oxide and soil aeration. A darker soil usually contains more organic matter and has higher soil fertility. Nutrient Expert® uses the information on soil colour as an important indicator of soil fertility and hence nutrient response in a particular farmer's field.

Choose one of the three options in Question 2, "Reddish or yellowish", "Grayish or brownish" or "very dark soil with high organic matter" based on the soil colour in the farmer's field.

### 5.5.3 SOIL ANALYSIS INFORMATION

Nutrient Expert® has been developed to provide SSNM based fertilizer recommendations to millions of small and marginal farmers of South Asia who do not have access to soil testing facilities. However, if a farmer has access to soil testing then the available soil analysis data could augment the estimation of nutrient response in a particular farmer field.

Press “Yes”, if the soil in the farmer’s field was analyzed for available P and K in the past 3-5 years. Provide the fertility levels of soil P and K, “low”, “medium” or “high”, in question “3a” and “3b”.

Press “No”, if the soil in the particular farmer’s field was not analyzed within the last 3-5 years.

### 5.5.4 SOILS KNOWN FOR P FIXATION

Some of the soils especially red and lateritic are subjected to P fixation and reduces P availability. Soils with a great P-fixation capacity have less available P after fertilization than a soil with a low P-fixation capacity. Nutrient Expert® accounts for the P-fixation capacity of soil in the farmer’s field and predicts how much P must be added to the soil to achieve a target P level in the soil.

Press “Yes”, if the soil is known to be P-fixing else press “No”.

Press the “Estimate” button once all the inputs are given in the window to allow Nutrient Expert® to determine the expected N, P and K responses for the particular farmer’s field as illustrated in Fig 17.

Press “OK” to go back to the “SSNM Rates” page.



FIGURE 17.

Estimate yield responses to fertilizer N, P, and K

**Estimate yield responses to fertilizer N, P, and K**

Name and/or location:  Attainable yield:  t/ha (13.5% MC)

Growing environment:

**In the absence of omission plot results, we use general soil characteristics and nutrient balance to estimate yield responses.**  
Please note that the estimated responses are subject to verification and fine tuning (e.g. through farmer participatory evaluation).

1. Soil texture:  light  medium  heavy

2. Soil color and organic matter content:  reddish or yellowish  grayish or brownish  very dark soil with high organic matter

3. Has the soil in this field been analyzed for P and K in the past 3–5 years?  yes  no

3a. Choose the level of soil P  low  medium  high

3b. Choose the level of soil K  low  medium  high

4. Is your soil known to be P-fixing?  yes  no

The estimated yield responses (at 13.5% MC) are:

N response:  t/ha P response:  t/ha K response:  t/ha

## 5.6 DETERMINING FINAL SSNM RATES

Pressing “OK” in the above window (Fig 17) will take the user back to the main “SSNM Rates” module where the estimated nutrient responses will appear in the appropriate boxes below Question 6. Simultaneously, the SSNM rates for the predetermined attainable yield (Question 1 of “SSNM Rates” module) and the estimated nutrient responses will be highlighted in the ready reckoner tables and the final N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O rates will appear below the tables in terms of kg per hectare basis.

## 5.7 ACCOUNT FOR NUTRIENT CREDITS

Nutrient credits are determined through a nutrient balance approach considering P and K sources such as crop residue, organic fertilizer, and carryover (residual benefit) from previous crop. The N content of organic inputs is considered minimal compared to the total N requirements of wheat; hence no N credit for organic sources.

Nutrient Expert® uses the combined nutrient balance of the crop grown before wheat (previous crop) and the current wheat crop to determine the possibility of accounting for nutrient credits. Nutrient credits refer to the allowable reductions in the recommended P and K rates. If the nutrient balance is positive (i.e. nutrient added is greater than nutrient removed), Nutrient Expert® provides an option for reducing the recommended rates through the nutrient credits. If the nutrient balance is zero or negative, nutrient credits will be zero and the recommended rates can no longer be reduced.

Press “Yes” if the user wants to check for excess nutrients in the system that can be used to reduce the recommended rates for the current wheat crop.

Press “No” if the user does not want to consider possible reductions in the recommended rates.

The report of the output of the “SSNM Rates” module could be saved as a pdf file or may be printed by pressing the “Report” button at the left bottom corner of the screen.

Press the “Next” button to go to the “Sources and Splitting” module.



## Chapter 6



### WORKING WITH THE SOURCES AND SPLITTING MODULE

This module converts N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O rates, calculated in the “SSNM Rates” module, into fertilizer sources, and rates of actual product, that are available with the farmer. This is important as most small and marginal farmers do not have the capacity to transform nutrient rates in to desired amounts of fertilizer sources. Further, this module helps in deciding the right time of application of fertilizers as well as splitting of N and K fertilizers to match nutrient application with crop requirement.

#### INFORMATION REQUIRED

- Locally available inorganic fertilizers (single and compound) – identified by the user in the “Settings”

#### EXPECTED OUTPUT

- Options for translating the recommended N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O rates into locally available single-element or compound fertilizer sources
- A fertilizer guideline with the right source, right rate, and right time of fertilizer application tailored for a field or growing environment

The final calculated N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O rates in the “SSNM Rates” module is the input for **Question 1** of “Sources and Splitting” module and is automatically transferred from the previous module.

**Question 2** allows the user to modify information about the growing environment that was provided earlier.

For “Irrigated”, “Favorable Rainfed” and “Less Favorable Rainfed” situations, select the appropriate box in **Question 2**.

Select a preferred splitting such as “Two times (80:20)”, “Two times (50:50)” or “Three times” in **Question 3**.

In **Question 4**, the user needs to select the fertilizer sources to be applied as basal application. If the user intends to use straight grade fertilizer sources, then press “Single sources” option and select the preferred fertilizer sources from a new window (Fig 18).

FIGURE 18.

The screenshot shows a dialog box titled "Inorganic fertilizers" with a close button in the top right corner. The main heading is "Single sources". Below this, the "Field size" is set to "0.4 ha". There are three columns for selecting fertilizer sources: "N source:", "P source:", and "K source:".

N source:	P source:	K source:
Urea	Single Super Phosphate	Muriate of Potash
Ammonium Sulphate	Triple Super Phosphate	
Anhydrous Ammonia		
Calcium Ammonium Nitrate (CAN)		
Zincated Urea		

At the bottom of the dialog box are two buttons: "OK" and "Cancel".

If the user plans to use any of the complex fertilizers, press “Compound fertilizers” and choose the preferred P-containing fertilizer source from the newly opened window (Fig 19). In such a case, the system will automatically select default fertilizer sources for N and K.

FIGURE 19.

The screenshot shows a dialog box titled "Inorganic fertilizers" with a close button in the top right corner. The main heading is "Compound fertilizer". Below this, the "Field size" is set to "0.4 ha". There is one column for selecting a "P source:".

P source:
Diammonium Phosphate
10-26-26
12-32-16
14-28-14
15-15-15
20-20-0
28-28-0

At the bottom of the dialog box are two buttons: "OK" and "Cancel".

After selection of single source or compound fertilizers, a new window will open to show the fertilizer application schedule for the given field and the yield target (Fig 20).

FIGURE 20.

Home Settings Help

## Nutrient Expert for Wheat

Current FFP and Yield
SSNM Rates
Sources and Splitting
Profit Analysis

Name and/or location:  Field size:  ha

1. What are the recommended fertilizer N, P, and K rates? N P<sub>2</sub>O<sub>5</sub> K<sub>2</sub>O

kg/ha

2. What is the growing environment?

Irrigated
  Favorable rainfed
  Less favorable rainfed

3. Select an option for fertilizer N splitting.

Two times (80:20)
  Two times (50:50)
  Three times

4. Select fertilizer source(s) for N, P, and K for the 1st application.

Single-element fertilizers

Compound fertilizers

**1<sup>st</sup> application at**  **DAS**

Source	Amount (kg)	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O
		-----kg-----		
Diammonium Phosphate	53	10	24	0
Urea	0	0	0	0
Muriate of Potash	54	0	0	32

**2<sup>nd</sup> application at**  **DAS**

Source	Amount (kg)	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O
		-----kg-----		
Urea	50	23	0	0

**3<sup>rd</sup> application at**  **DAS**

Source	Amount (kg)	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O
		-----kg-----		
Urea	50	23	0	0

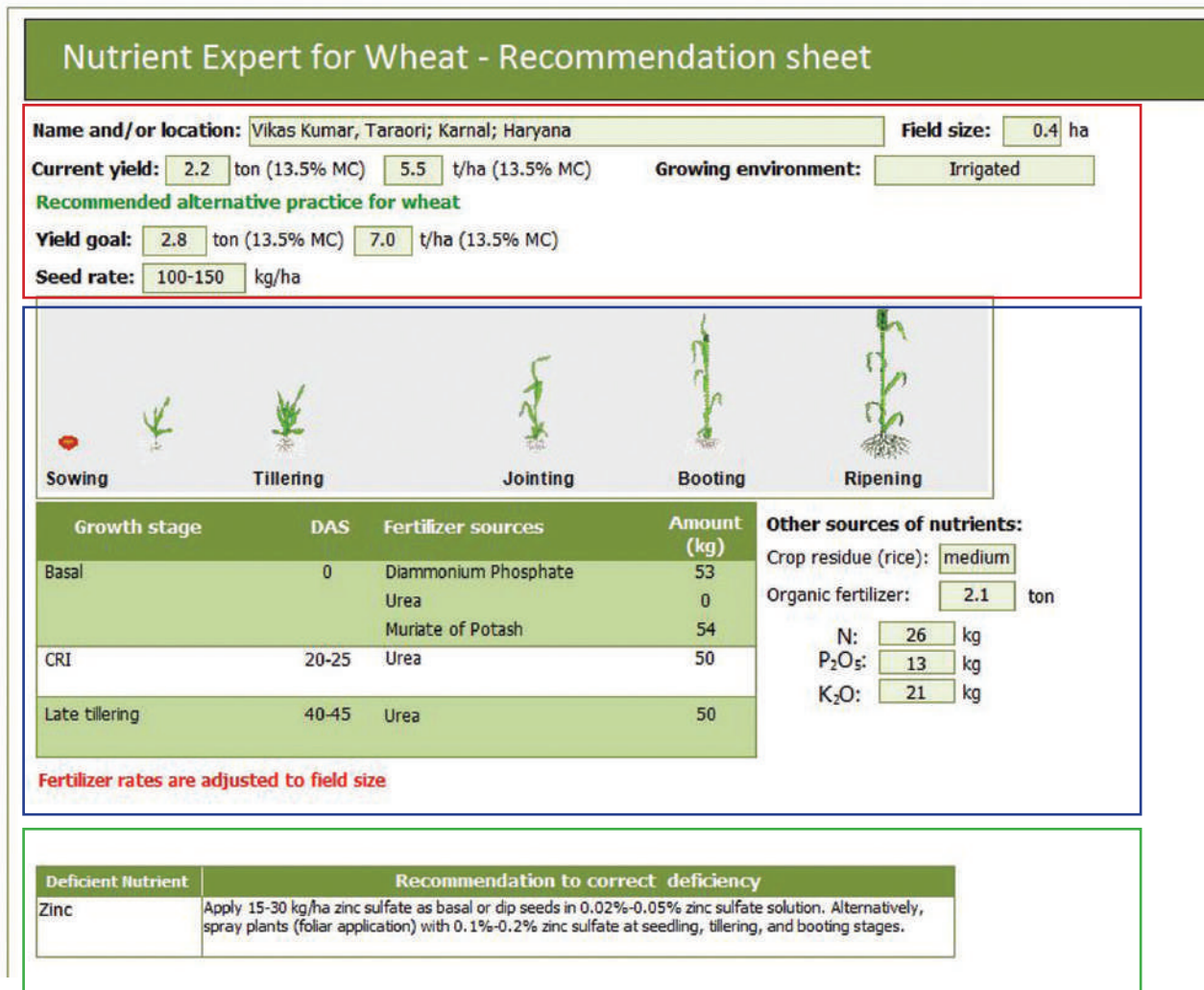
Fertilizer rates are adjusted to field size

Report
Reset

< Back
Next >
Close

Press the “Report” tab at the left bottom corner of the screen to open the final report (Fig 21) that could be printed out for sharing with the farmer. The report could also be saved as a pdf file in the computer for future use.

FIGURE 21.



Three sections of the final report (Fig 21) has been highlighted by coloured boxes and represents the following information:

- **Red box** – describes the farmer with his name, address, growing season, field size, current yield, growing environment, and the targeted yield for which the recommendation is developed.
- **Blue box** – identifies the main physiological stages of wheat, time of application of fertilizers matching the physiological stages, sources of fertilizers to be used and their amount to be applied in terms of 50 kg bags. It also shows the amount of nutrients coming from the organic sources used by the farmer in the current crop.
- **Green Box** – indicates the rate of deficient secondary or micronutrients to be applied, in this case zinc, that were flagged as deficient in the “SSNM Rates” module. The secondary and micronutrient recommendations are based on current state recommended rates.

Press the “Next” button to go to the “Profit Analysis” module.

**Chapter 7****WORKING WITH THE “PROFIT ANALYSIS” MODULE**

Any nutrient management programme is considered viable only when the economic returns from such strategy is superior over the existing practices. The “Profit Analysis” module allows users to estimate the economic advantage of Nutrient Expert® based recommendations over the existing generalized management.

**INFORMATION REQUIRED**

- Farm-gate price of wheat grain.
- Cost of seeds.
- Costs of fertilizers (estimated from quoted fertilizer prices as defined by the user in “Settings”).

**EXPECTED OUTPUT**

- Comparison of expected costs and benefits between the farmer’s current practice and the recommended practice.

In the first section of the “Profit Analysis” module, the user is asked to provide the seed rate, cost of seed and the farm-gate price of wheat for both the nutrient management options. Nutrient Expert® combines this information with the information provided in the other modules to arrive at an estimate of gross return over fertilizer cost in the SSNM based recommendation and the farmer’s practice (Fig 22). The ex ante analysis finally highlights a profit estimate of the improved nutrient management practice and builds confidence to the farmer in adopting the new strategy of nutrient management.

FIGURE 22.

[Home](#)   [Settings](#)   [Help](#)

## Nutrient Expert for Wheat

Current FFP and Yield
SSNM Rates
Sources and Splitting
Profit Analysis

Full Report

Farmer's current practice    Recommended practice

Seed rate:  kg/ha     kg/ha

Cost of seeds:  INR/kg     INR/kg

Price of wheat:  INR/kg

Full Report

Profit analysis
Grain Equivalent of Fertilizer

Simple profit analysis	Farmer's current practice	Recommended practice
Yield at 13.5% moisture (t/ha)	5.5	7
Price of wheat (INR/kg)	10.00	10.00
<b>REVENUE (INR/ha)</b>	<b>55,000</b>	<b>70,000</b>
Seed cost (INR/ha)	6,000	5,000
Fertilizer cost – inorganic sources (INR/ha)	4,940	8,491
Fertilizer cost – organic sources (INR/ha)	0	0
<b>TOTAL COSTS (INR/ha)</b>	<b>10,940</b>	<b>13,491</b>
<b>Expected benefit above fertilizer costs (INR/ha)</b>	<b>50,061</b>	<b>61,509</b>
<b>Expected benefit above seed and fertilizer costs (INR/ha)</b>	<b>44,061</b>	<b>56,509</b>
<b>Change in benefit (INR/ha)</b>		<b>12,448</b>

Report
Reset

< Back
Close

Press “Full Report” on the top right side corner to generate a complete report consisting information of all the modules. The “Full Report” may be saved as a pdf file or may be printed for distribution.

## References

Buresh, R.J. (2008). Management made easy: A new decision-making tool is helping rice farmers optimize their use of nutrient inputs. *Rice Today*, October-December 2008. International Rice Research Institute.

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FAI, 2012. Fertilizer Statistics 2011-12. The Fertilizer Association of India

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## Appendix

### A. REQUIRED INFORMATION — QUESTIONS ASKED (LISTED BY MODULE)

#### A. CURRENT FFP AND YIELD

This refers to the wheat-growing season under consideration (as specified above).

1. What is the yield of wheat for a typical season in the past 3 to 5 years? Provide total amount of harvested grain from your field (measured at shelling).

Field size: \_\_\_\_\_ ha

Fresh weight: \_\_\_\_\_ (ton)      Moisture content (if known): \_\_\_\_\_ (%)

2. How much fertilizer do you apply to your wheat field? Specify no. of fertilizer application, timing or schedule of each application (i.e. days after sowing), fertilizer source and amount applied.

Inorganic fertilizers

Application no.	Days after sowing	Fertilizer (s)	Weight of full bag (kg)	No. of bags
1				
2				
3				

Organic fertilizers

Fertilizer (s)	Weight of full unit (kg)	No. of units





**B. SSNM RATES**

1. What is the attainable yield for your location? \_\_\_\_ (t/ha)

You may enter the value if known.

If the attainable yield for the location is still unknown, answer the questions in the box below.

**Describe the growing environment:**

1. Water availability (source of water)
  - Irrigated       Fully rainfed       Rainfed with supplemental irrigation
  - 1a. If irrigated, do you have an estimate of K input from irrigation water
2. Low Temperature or frost incidence problems
  - often       seldom       never
  - [often = 2 or 3 out of 5 times; seldom = 1 out of 5 times]
3. Drought problems
  - often       seldom       never
  - [often = 2 or 3 out of 5 times; seldom = 1 of 5 times]
4. Soil-related problems or constraints (note: answer can be more than one)
  - a. acidity Soil pH: \_\_\_\_ (If pH is below 5.3, liming is recommended)
  - b. deficiency of secondary and micronutrients (select from a list: boron, copper, iron, magnesium, manganese, sulfur, zinc)
  - c. problem soils (select from a list: acid sulfate soils, degraded soils, saline soils)
  - d. none

2. What do you do with wheat residues after harvest?

- remove all the above ground residues from the field
- retain 20% of above ground residue on the surface
- retain 20% of above ground residue and incorporate
- retain 20% of above ground residue and burn

3. Will you apply organic fertilizers (e.g. manure)?  Yes       No

If Yes, list the fertilizer source (e.g. chicken manure) and amount to apply for a given field size.

Fertilizer (s)	Weight of full unit (kg)	No. of units

4. Determine the residual benefit from your previous crop?  Yes       No

a. What crop did you grow in the previous season?

- maize       rice       other crop       fallow

- b. What was the tillage practice  
 zero till     reduced till     conventional till
- c. What was the source of water availability  
 irrigated     fully rainfed     rainfed with supplemental irrigation
- d. What was the yield of your previous crop? (t/ha)
- e. How did you manage the residue after harvest of your previous crop?  
 If **maize**, choose from the following options:  
 removed all above ground residues from the field  
 retained all stover in the field for incorporation to next crop  
 retained 50% of stover for incorporation to next crop  
 retained all stover in the field and burned  
 retained 50% of stover in the field and burned
- If **rice**, choose from the following options:  
 removed all above ground residues from the field  
 retained stubble and removed straw from the field  
 retained all above ground residue on the surface  
 retained stubble and burned straw  
 retained all above ground residue in the field and burned  
 retained stubble, burned straw, and incorporated
- If **other crop**, choose from the following options:  
 removed all above ground residues from the field  
 retained crop residues for incorporation to next crop
- f. How much fertilizer did you apply to your previous crop?  
 (List down both inorganic and organic sources and amounts applied. For inorganic fertilizers, always indicate the fertilizer grade (% N, %P<sub>2</sub>O<sub>5</sub>, and %K<sub>2</sub>O); for organic sources, indicate nutrient content if known or available.)

#### Inorganic fertilizers

Fertilizer (s)	Weight of full bag (kg)	No. of bags

#### Organic fertilizers

Fertilizer (s)	Weight of full unit (kg)	No. of units

5. Do you have results from omission plot trials conducted in a similar field in your district?

Yes       No

If Yes: N response: \_\_\_\_ t/ha; P response: \_\_\_\_ t/ha; K response: . \_\_\_\_ t/ha.

If No, answer the questions inside the box:

1. Soil type:            (a) light            (b) medium            (c) heavy

2. Soil color and organic matter content:

- reddish or yellowish color  
 grayish or brownish  
 very dark soil with high organic matter

3. Has your soil been analyzed for P and K in the past 3-5 years?  Yes     No

If Yes:

3a. Choose the level of soil P:                     low             medium             high

3b. Choose the level of soil K:                     low             medium             high

6. Do you wish to account for nutrient credits?  Yes     No

### C. SOURCES AND SPLITTING

(This section will use a list of available fertilizer sources in the area/location, identified by the user through the Settings section of the software.)

Select an option for fertilizer N splitting:

two times (80:20)                     two times (50:50)                     three times (50:25:25)

Select an option for growing environment

Irrigated                     Favorable rainfed                     Less favorable rainfed

Select an option for fertilizer source

Single-element fertilizers             Compound fertilizers

### D. PROFIT ANALYSIS

Seed rate (kg/ha)

Farmer's current practice                     Recommended practice

Cost of wheat seeds: \_\_\_\_ (INR/kg)

Farm gate price of wheat: \_\_\_\_ (INR/kg)

## B. LIMING

Liming is recommended when the soil pH is less than 5.3. The lime requirement is given in ton of CaCO<sub>3</sub> (adjusted to field size) and it is calculated as:

$$\text{Lime requirement (t, CaCO}_3\text{)} = (5.3 - \text{current pH}) * 4 * \text{Field size (ha)}$$

The lime requirement is expected to increase soil pH to 5.3, the lower limit of the optimal pH range for wheat. It is assumed that 400 kg of lime per ha is needed to increase the pH by 0.1 unit.

Application of lime requirement must be done about two weeks before planting. The neutralizing effect of the applied lime may last for a few seasons or years; hence liming may not be done every cropping season, but regular monitoring of the soil pH is recommended to determine need for subsequent liming.





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