

## Variable Rate Fertilizer Application: Boon for Farmers

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Nutrient requirement is different based on type of plant, plant growth stage and availability of nutrient in the soil. But, traditionally fertilizer has been applied either over or under dose because of uniform application without considering any inherent variability. This method also has the less fertilizer use efficiency.

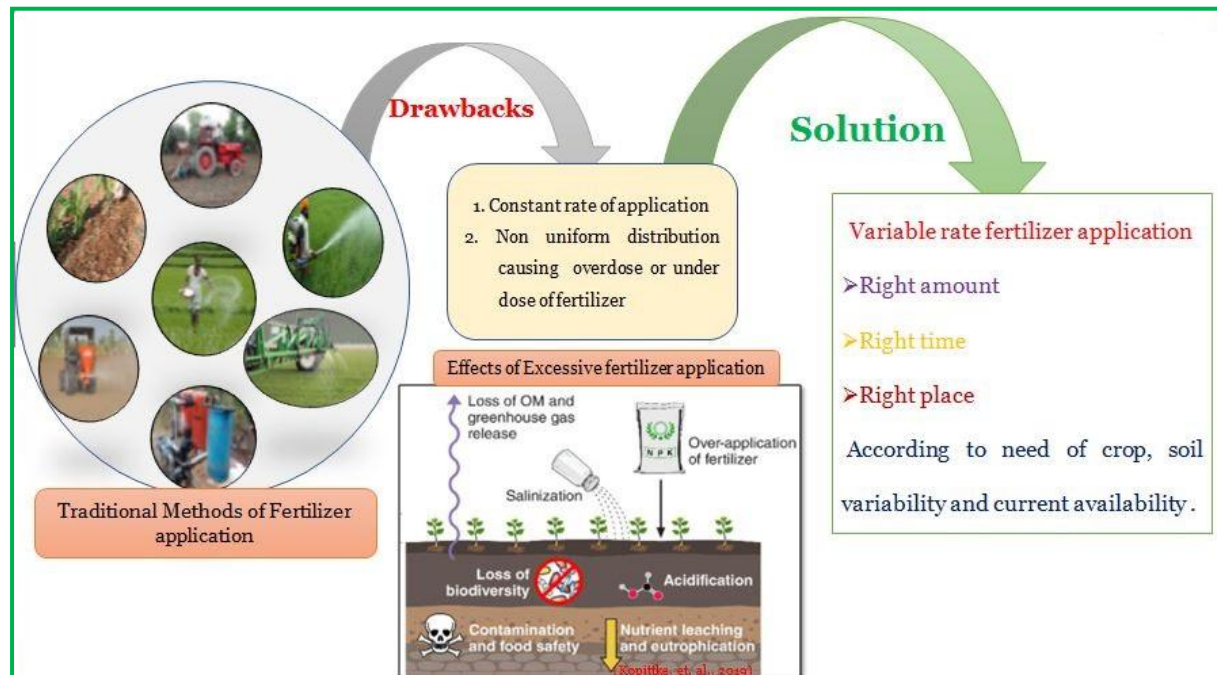
The traditional methods of fertilizer application are broadcasting, top dressing, side dressing, using fertilizer broadcaster, starter solution, fertigation, etc. Broadcasting, top dressing, and side dressing fail to apply fertilizer uniformly. Whereas fertigation, Broadcaster, Seed-cum-fertilizer drill successfully applies fertilizer in constant rate or equal dose to each plant but, none of the above mentioned methods consider the variability in the field. Fig. 1 depicted the uneven growth of the plant. Uniform fertilizer application rate across entire fields can result in over or under incorporation of nutrient. Over dose or under dose of fertilizer application by traditional methods causes reduction in profit per unit of crop also over dose is harmful for the environment. The under dose of fertilizer causes stunted plant growth. Continuously uniform application of chemical fertilizer in Indian agriculture not only increases the cost of production but also raising a big environmental threat in terms of soil and ground water pollution. Also causes permanent infertile land, Cancer in human and cattle. The fertilizer use efficiency is also less in this method for Nitrogen 30-50%, for Phosphorous 20-45% and for Potash 50% (Korkmaz, 2007; Sonmez *et. al.*, 2008).



Fig. 1: Uneven growth of crop

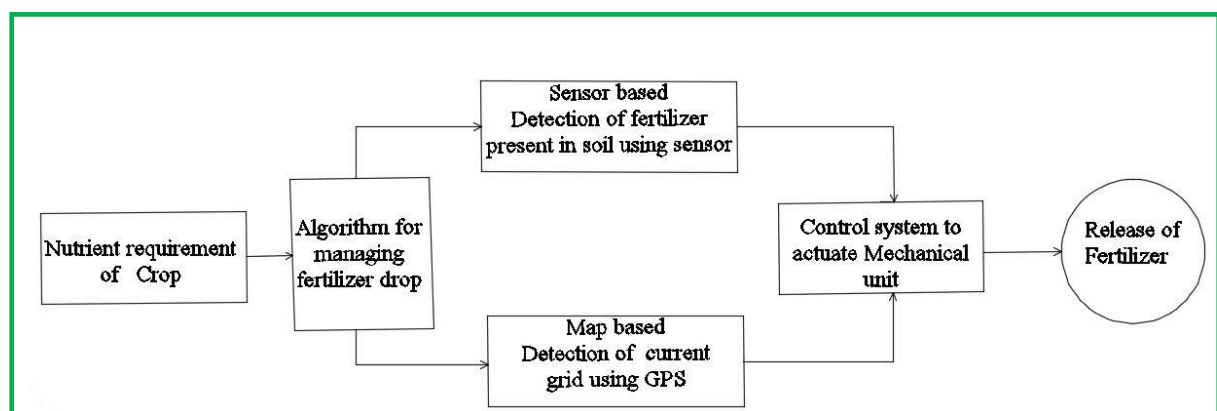
The proper assessment of required amount of nutrient for particular crop at different locations is important, which will assist to make customized dose of fertilizer that should be applied in a precise quantity, at required location. “Variable Rate Technology (VRT)” is a solution for all above problem. This method is able to apply the crop input like lime, water, seed, fertilizer, etc. at a right amount, right time and right place according to need of crop, soil

variability and current availability. Figure 2 represents the need of variable rate fertilizer application.



**Fig. 2: Need of variable rate fertilizer application**

Map-based method and sensor-based method are two basic methods of implementing site-specific management for the variable rate application (Ess *et. al.*, 2001; Morgan and Ess 2003; Wahid *et. al.*, 2004). To reduce the overdose or under dose of fertilizer, some researchers have developed a fertilizer applicator based on either map based method or sensor based method. In the map based approach a prescription map is generated based on soil analysis or other available information and then used by the VRT to control the desired application rate (Sharma *et. al.*, 2014). The sensor-based VRT method employs sensors to measure the site-specific characteristics of a field, and uses that information immediately through a set of decision rules (or algorithms) to control a variable rate input applicator on-the-go (Lowenberg, 2004). Fig. 3 shows the flowchart of variable rate fertilization process.



**Fig. 3 Flowchart of the variable-rate fertilization process**

### Construction and Working of Variable rate fertilizer applicator (VRFA)

The VRA system components,

1. **Computer** – It serves two purpose i) Ability to run the application control software and ii) Serves as the user interface.

2. **Controller** -Processes and controls the application rate, can be a separate system from the software and control mechanism. It uses the set point rate from the software and ensures the control mechanism (motor or actuator) is putting out the appropriate rate. It uses feedback from a ground speed radar (GSR) or other speed sensor to compensate for speed variations while also using a speed or position feedback from the control mechanism to ensure it is turning at the appropriate speed or positioned correctly.
3. **Sensors** – Sensors sense the different information (i.e. nutrient content in the soil or crop), and transmit this information to controller
4. **Software** -Provides the ability to view prescription maps, determine the desired application rate based on field position, and logging. It reads the uploaded prescription map and communicates the desired application rates to the controller.
5. **GPS Receiver** -Provides position information which is used by the control software to adjust rates based on prescription map. It provides the ability to spatially log the actual rates applied for the generation of as-applied maps.
6. **Control and/or Metering Mechanism** -The component which directly controls the feed rate.

### Value Proposition

Agriculture is backbone of Indian economy. About 70% population is engaged with agricultural activities. The population is also growing up day by day, thus food demand is also increases. Now, this is stage that, this is very needful to adopt precision agriculture practices for fulfilling the food demand and also for saving the environment. The Variable rate fertilization technology will reduce the cost of production by minimizing the wastage of fertilizer traditional methods. It will contribute for improvement in soil fertility and also reduce the risk of environmental pollution. The automatic assessment and application of nutrients will reduce human intervention reducing labour cost and error. By using this technology the farmers yield is increasing by 10-20%, also farmers can able to save the fertilizer up to 25%. The calculated and precise application of nutrients will improve production of crops in terms of quantity as well as quality of produce, in term increase benefits to cost ratio (B:C). The variable rate fertilizer application system may require higher initial investment, but the cost of production will be reduces with additional benefit of saving the environment. If farmers use this machine through custom hiring centre (which is more than 10000 in India), then it becomes profitable for farmers.

### Way Forward

It is exciting to continue working on this problem and take the VRFA to the market, as would helpful for farmers. Also we are interested in commercialization this technology. We are interested to aware this for farmers through front line demonstration and short trainings. The technology can be transferred to commercial manufacturers to make it available to the farmers on large scale. Technology can be propagated through custom hiring centers insuring availability to small farmers also. This will attract educated youth to take agriculture service industry as their career option.

### Impact of VRFAS-

- Positive impacts on economics of agriculture and environmental improvement of agricultural ecosystem.
- Ensures the long-term health and sustainability of land and water resources used for agricultural production.
- Reduced chemical and human energy input in agriculture with higher yield and quality produce. Thus more crops can be grown with saved inputs.
- Develop sustainable custom hiring business and attract educated youth to agriculture.

- Fewer chemicals will attract exports of the agricultural commodities.
- Minimizes negative impacts and risks to the environment.

“The farmer is the only man in our economy who buys everything at retail, sells everything at wholesale, and pays freight both ways” John F. Kennedy

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