Role of Precision Farming in Sustainable Development of Hill Agriculture

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Abstract

Precision farming concept was initiated for site specific crop management as a combination of global positioning system (GPS) technology, variable rate technology (VRT), remote sensing, yield mapping etc. to optimize the profitability, sustainability with a reduced environmental impact. With rich land, abundant water and a favorable climate, hill agriculture in India has considerable potential to grow, and contribute towards improving farm incomes, enhancing food and nutrition security, and accelerating the overall growth of the region. Unfortunately the growth potential of hill agriculture has remained under-exploited. Precision farming is the best remedy for the problems faced by farmers on hills. Various issues of lack of system-specific production technologies, difficult terrains, inaccessible habitations, crushing of crops by wild animals, management of small, scattered, fragmented, uneven lands etc. can be sought out easily with the methods of precision farming. Precision farming not only may utilize fully resources, reduce investment, decrease pollution of the environment but also get the most of social and economic efficiency. Precision farming methods helps in recognizing areas by farmers that have productivity problems and to select the best solution, as on hills much of the land strips may have productivity problems due to erosion, runoffs, low temperature etc. The precision farming model for hills in India while addressing these issues would provide an innovative route for sustainable agriculture in globalised and liberalized economy. The speed of transformation to precision farming depends much on the level of commitment of politicians, scientists and technocrats at whose mercy the farmer really is.

Key words: GPS, Hill Agriculture, Remote Sensing, VRT, Yield Mapping

Introduction

Precision Agriculture is the application of technologies and principles to managespatial and temporal variability associated with all aspects of agricultural production forimproving production and environmental quality. The technologies of precision agriculture: Computers, Global Positioning System (GPS), Geographic Information System (GIS), Remote Sensing (RS) and Application control.

The potential of precision farming can be visualized through reduced use of water, fertilizers, herbicides and pesticides besides the farm equipments. Instead of managing an entire field based upon some hypothetical average condition, which may not exist anywhere in the field, a precision farming approach recognizes site-specific differences within fields and adjusts management actions accordingly.Farmers usually are aware that their fields have variable yields across the landscape. These variations can be traced to management practices, soil properties and/or environmental characteristics. All these factors lead to the urged use of precision farming on hills which will lead to sustainability. There are certain objectives that is fulfilled using precision agriculture; they are as follows

Easy management of inputs

In hills farmers usually faces problems regarding the use of the inputs, whether it be the availability, constant use in field, lack of irrigation, all can be solved with the help of precision farming methods.

Convenience to keep a watch 24x7

By the use of Global Positioning System(GPS), and remote sensing technology it's become very

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convenient for farmers on hills to keep a better watch over their farms every time. Usually farmers on hills find it tough to travel long distances from their home on the base of hills to go to uphill just to keep a watch on their farms, so by remote sensing he can get pictures directly to their home 24X7.

Sustainability

Sustainability of resources is very crucial for farmers on hills to get a constant produce. If the farmer needs to get a good profit for the long term he needs to keep performing sustainable farming actions, and that is practices of precision farming added with sustainable practices. Alone precision farming may not be able to sustain resources, sustainable practices needs to complement practices of precision farming.

Materials and Methods

Precision farming is still only a concept in many developing countries and strategicsupport from the public and private sectors is essential to promote its rapid adoption.Successful adoption, however, comprises at least three phases including exploration,analysis and execution. Data on crop yield, soil variables, weather and other characteristicsare collected and mapped in the exploratory stage, which is important for increasing theawareness among farmers of long term benefits. The approaches to data collection andmapping must, therefore, reflect local needs and resources.

In the analysis stage, factors limiting the potential yield in various areas within a fieldand their interrelationships are examined using GIS-based statistical modeling. It showed that quantitatively important yield variation may occur over distances as shortas 10m, however, only some factors such as soil structure, water status, pH, nutrient levels,weeds, pests and diseases can be controlled but not the others (soil texture, weather, topography). After determining the significance of each source of variability to profitability of aparticular crop and relative importance of each controllable factor, management actions canbe prioritized. It must be remembered that in some low yielding areas, the reason for pooryields may be the lack of sufficient soil nutrients in the first place. In such cases, applicationbeyond just replenishment is necessary.

Lastly, execution phase includes variable application of inputs or cultural operations. However, it is not always necessary touse variable rate applicators. Efforts must, therefore, initially focus on limiting indiscriminateuse of inputs in conventional methods. Once the economic and environmental benefits areknown widely, variable rate technology would be rapidly implemented at least in high valuecrops.

By following these methods, a farmer on hills can easily manage its resources and can get a very good yield, and thus can lead to sustainability in near future.

Results and Discussion

To spur adoption of precision farming methods in developing countries, pilot demonstration projects must be conducted at various growers' locations by involving farmers in all stages of the project. The pilot projects must attempt to answer the grower's needs and emphasize the operational implementation of technology and complete analysis of the costs and savings involved. Documentation of pilot projects would help in examining the operational weaknesses and identification of remedial measures. The projects can be used to train innovative farmers and early adopters, expose the neighboring nonparticipating farmers to the new technologies, and show the usefulness of the technology for short and long-term management.

The role of agricultural input suppliers, extension advisors and consultants in the spread of these technologies is vital. For instance, public agencies should consider supplying free data such as remotely sensed imagery to the universities and research institutes involved in precision farming research. Also, professional societies of agronomy, agricultural informatics, and engineering must provide training guidance in the use of technologies. The involvement of inter/disciplinary teams is essential in this. Small farm size will not be a major constraint, if the technologies are available through consulting, custom and rental services.

The role of agricultural cooperatives is important in dissemination of precision farming technologies to small farmers. If precision farming is considered a series of discrete services: map generation, targeted scouting, it is possible to fit these services within the structure of a progressive agricultural cooperative in each developing country. Changes in agricultural policies are also necessary to promote the adoption of precision farming. There are basically two policy approaches: regulatory policies and market based policies. The former refer to environmental regulations on the use of farm inputs and later refer to taxes and financial incentives aimed at encouraging growers to efficiently use farm inputs. In most developing countries the lack of penalties for pollutant generation has partly contributed to an excessive use of inputs.

Subsidies on inputs and outputs and mechanisms that prevent the price system from rationing limited resources are also common. The latter include state-guaranteed crop prices, tariffs, import quotas, export subsidies. Inputs such as water and fossil fuels are usually sold at prices that are well below the real resource cost of their use, which consists not only production costs but also includes scarcity value and costs of pollution. In such cases, the formulation of policies that reflect the real scarcity value of natural resources and penalize pollution and policies such as green payments for farmers adopting techniques that would lower environmental costs can promote the adoption of precision farming technologies.

At the same time, some consumers in India would like to see a drastic reduction in the use of pesticides and fertilizers, and are willing to pay as much as 4 to 6 times the normal price for produce such as organic vegetables, soybean and wheat. When the price elasticity of input use is low and the input costs are only a small part of the total production expenditure, as in the case of fertilizers and pesticides. Very high taxes are required to reduce their use adequately. Given the unfeasibility of such high taxes, a hybrid policy may be implemented for controlling pollution. A tax-free quota of N can be combined with taxes on additional N use.
At the research level, many issues remain to be resolved. The development of standards for the hardware and software (image transfer formats and GPS transfer formats, map projection formats) is another issue. Crop models and decision support systems must be improved by considering local resources. Data for calibration of models must be made available to increase their accuracy and/or predictability.

The ability to finance a creative information venture in agriculture will affect the speed of diffusion of precision farming technologies. Commercial banks, as well as other sources of funding, have to be educated regarding the potential of precision farming

Precision farming has created scope of transforming the traditional agriculture, through the way of proper resource utilization and management, to an environmental friendly sustainable agriculture.

Precision farming is essential for serving dual purpose of enhancing productivity and reducing ecological degradation. The success stories pertaining to Precision Agriculture have mainly drawn from the developed countries; wherein agriculture ischaracterized by highly mechanized and automated systems, and is driven by market forces and has been professionally managed enterprise. The adoption of precision farming depends on product reliability, the support provided by manufacturers and the ability to show the benefits. Effective coordination among the public and private sectors and growers is, therefore, essential for implementing new strategies to achieve fruitful success. The Precision Farming model for India while addressing these issues would provide an innovative route for sustainable agriculture in globalised and liberalized economy.

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