A CASE STUDY | International Journal of Agricultural Engineering | Volume 5 | Issue 1 | April, 2012 | 117 – 120

Precision farming-scope and scenario in small farms

B. JAYANTHI AND G. PRASHANTH

Received : 08.12.2011; Revised : 22.01.2012; Accepted : 01.03.2012

See end of the Paper for authors' affiliations

Correspondence to:

B. JAYANTHI
Division of Agricultural Engineering, University of Agricultural Sciences, G.K.V.K., BENGALURU (KARNATAKA) INDIA
Email : jayanthi.balaji2@gmail.com

Abstract **:** Precision farming is a concept of using the new technologies and collected field information, doing the right thing, in the right place, at the right time. Collected information may be used to more precisely evaluate optimum sowing density, estimate fertilizers and other inputs needs, and to more accurately predict crop yields. Surveys conducted of Southern cotton producers since 2000 indicate continued adoption of precision farming technology and a significant increase in the use of GPS guidance. According to surveys of cotton grower adoption in the 2000, 2004 and 2008 seasons, 63 per cent of farmers who responded are now using some form of precision farming. In India,with installation of drip irrigation system and fertigation (for application of soluble fertilizers) units being essential requirements, farmers could avail a 50 per cent subsidy for the equipment. A farmer could avail a maximum subsidy of Rs.65,000 a hectare, including the cent per cent subsidy of Rs.25,000 for soluble fertilizer. Precision farming on a regional level is one way to apply this approach to small-farm agriculture. It may not only improve farm management, but may also promote the development of rural areas.

Key words **:** Geographical positioning system(GPS), Variable rate technology, Crop yield

How to cite this paper **:** Jayanthi, B. and Prashanth, G. (2012). Precision farming-scope and scenario in small farms. *Internat. J. Agric. Engg.*, **5**(1) : 117-120.

Precision farming in the context of Indian Agriculture is the precise application of agricultural inputs based on soil, weather and crop requirement to maximize sustainable productivity, quality and profitability. 'Precision farming or precision agriculture' is a concept of using the new technologies and collected field information, doing the right thing, in the right place, at the right time. Collected information may be used to more precisely evaluate optimum sowing density, estimate fertilizers and other inputs needs, and to more accurately predict crop yields. It helps in avoiding unwanted practices to a crop, regardless of local soil/climate conditions, *i.e.*, it reduces labour, water, inputs such as fertilizers, pesticides etc. and assures quality produce.

The term 'precision farming' or 'precision agriculture' is capturing the imagination of many people concerned with the production of food, feed, and fiber. It offers the promise of increasing productivity, while decreasing production costs and minimizing the environmental impact of farming (NRC 1997, SKY-Farm 1999).

Scope of precision farming in other countries:

The mechanization of American agriculture has been ranked as one of the top 10 engineering accomplishments of the past century, right alongside the invention of the computer and putting a man on the moon. Randy Taylor, Extension agricultural engineer at Oklahoma State University, told the general session of the Beltwide Cotton Conferences in New Orleans that electronics and control systems for use in precision agriculture could match in importance such things as the tractor and the rubber agricultural tire, both key elements of the mechanization of agriculture in the last century.Satellite guidance systems for tractors burst upon the American agriculture scene in the 1990s, leading the way to an era of precision agriculture that has quickly matured, with many opportunities ahead, according to Jon Hardwick, Newellton, La., cotton producer, chairman of the National Cotton Council and moderator of the beltwide opening session.

Taylor said adoption of precision agriculture technology allows farmers to manage crops on a smaller or more finite scale without sacrificing the capacity of highly efficient, large equipment. Being able to farm in zones using yield mapping and sensing equipment as part of capabilities of tractor satellite guidance and mapping systems allows farmers to specifically identify differences in fields. Precision agriculture has allowed producers to accurately identify zones and do something about them using maps coupled with computer-generated application techniques.

Sensors and yield maps pick up those zones, but what they pick up may not always be easily corrected. For example, Taylor said sensors may pick up a high vigour area of the field with the assumption that it should be yielding well when in fact a yield monitor proves that to be untrue. Areas where a grower gets no response from increased nitrogen is another area that precision agriculture technology reveals that something is a mystery. Taylor says this has led to the new idea of "high zone management." He defined it as the fusion of sensory information with historical yield map data. The concept is another step in the evolution of precision agriculture.

Cotton is the one crop that is the most responsive to remote sensing. However, Taylor said many remote sensing companies using aircraft and satellite to collect aerial imagery to map fields are no longer in business because imagery cannot replace ground proofing. Surveys conducted of southern cotton producers since 2000 indicate continued adoption of precision farming technology and a significant increase in the use of GPS guidance. According to surveys of grower adoption in the 2000, 2004 and 2008 seasons, 63 per cent of farmers who responded are now using some form of precision farming. Respondents were identified as precision farming adopters if they used any type of information gathering technology, variable-rate management or GPS guidance. The survey, sponsored by cotton incorporated, found that for 2008, 35 per cent of respondents reported using at least one information gathering technology, 22 per cent reported making at least one variable-rate management decision and almost 50 per cent reported using GPS guidance. About 26 per cent reported using information technology to make variable-rate decisions and used GPS guidance. About a third of producers used GPS guidance without any other technology. Overall about 73 per cent of those designated as precision farming adopters used GPS guidance. About 30 per cent of those using information technology used zone sampling and grid soil sampling, with yield monitoring and aerial imaging the third and fourth most popular uses. The survey indicated producers have been using zone soil sampling and aerial imaging the longest, while electrical conductivity and yield monitoring are more recent adoptions. Over 90 per cent of respondents who reported making a variable-rate technology decision did so with fertilizers, according to the survey, followed by plant growth regulators. Use of variable-rate technology for drainage and harvest aids was also very common. According to Daniel Mooney, research associate at the University of Tennessee, "The yield monitor seems to be the most commonly used technology for most variable-rate decisions."

GPS guidance systems were most often used for spraying, about 80 per cent, followed by planting and tillage. The survey included only six states in 2000 and grew to 11 states by 2004. In 2008, Texas was added. Six universities are participating in tabulating and analyzing the data. From 2004 to 2008, in all states except Texas, there was an increase in zone sampling, yield monitoring and grid soil sampling while the use of aerial photography and handheld GPS devices decreased. Nearly 80 per cent of variable-rate management adopters reported the use of a yield monitor for fertility or lime management in 2008, about the same as in 2004. The percentage of variable-rate adopters using aerial or satellite imagery for fertility or lime increased from 40 per cent in 2004 to 50 per cent in 2008.

Scope of precision farming in India:

Over the past two years, precision farming techniques have been promoted in 900 hectares across the district in various crops including sugarcane, maize, brinjal, tomato, onion, tapioca, sunflower and groundnut.

With installation of drip irrigation system and fertigation (for application of soluble fertilizers) units being essential requirements, farmers could avail a 50 per cent subsidy for the equipment. A farmer could avail a maximum subsidy of Rs.65,000 a hectare, including the cent per cent subsidy of Rs.25,000 for soluble fertilizer, said Collector T. Soundiah, after inspecting some of the precision farming fields in the district on Tuesday.

The higher yield achieved through the drip irrigation systems and fertigation, under which the soluble fertilizer was applied through the drip irrigation system, has been an attraction for farmers (Kurt, 2009). A cluster-based approach was also being promoted under the scheme, so that small farmers in villages could come together to avail the subsidy given under the NADP in clusters of 20 hectares each. Farmers could achieve up to 50 per cent increase in yield by adopting precision farming techniques, according to S. Robert Vincent, Deputy Director of Horticulture.

Precision Farming Project was started in Tamil Nadu first in Dharmapuri district during 2004-2005. It was implemented initially in 250 acres in 2004-2005, 500 acres in 2005-2006 and 250 acres in 2006-2007. Government of Tamil Nadu had assigned this task to Tamil Nadu Agricultural University. An amount of Rs. 75,000/- for installation of drip irrigation and Rs. 40000/- for crop production purposes was given. The first crop has been taken up under the total guidance of Scientists from the University. Subsequent 5 crops had been taken up by the farmers in 3 years.In the first year, farmers were not ready to accept this project initially because of their frustration in agriculture due to continuous drought in that area for 4 years since 2002. But after seeing the success of the first 100 farmers and high market rate of the produce from this scheme, farmers started registering in large numbers for the second (90 per cent subsidy) and third year (80 per cent subsidy).

The initiation of GPS into farm operations is less than a decade old. Its use is fast spreading to all aspects of farm operations and beyond. Some of the areas in agriculture where precision farming is taking hold with implications for the economics of farming are listed below. Since the subject is vast and fast growing, it is difficult to compile a complete list of applications in this limited presentation.

Soil fertility management

– This involves dividing a field into several small and equal divisions using the sub-inch accuracy of GPS. To do this, the tractor is fitted with a dish antenna to receive signals from satellites, which are recorded on a tractor-mounted computer. Soil samples are mechanically taken from each sub-division and this process is technically known as "Grid Sampling."

– Samples are tested in a modern soil testing laboratory for about 17 parameters including physical and chemical characteristics of the soil and recorded.

– Using the test results of this grid samples, composite colour–grams are created through computer simulation on each of the17 parameters for the entire field (Fig. 1).

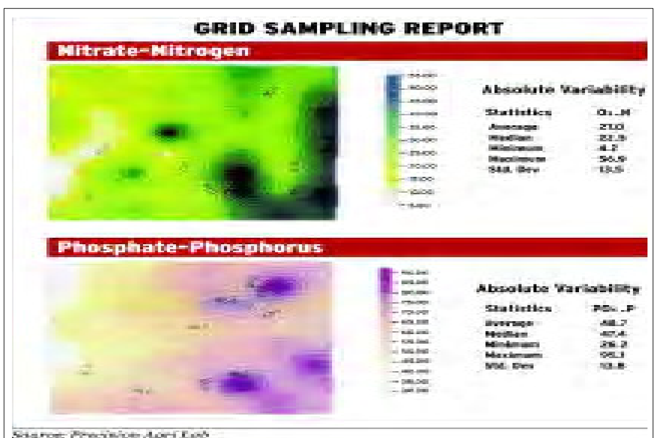

Fig. 1 : Grid sampling report

– The colour-grams are stored as stencils in the computer for various functions. One of the chief among the functions is balancing soil fertility of the field with respect to all major, secondary, and micro- nutrients. This is achieved through tractor-mounted computer guided spreader equipment capable of reading the variability of fertility from colour-grams. Fertilizers are then automatically applied at variable rates only to where they are needed as indicated by the colour-grams.

In practical experience, the savings in fertilizer cost from this variable rate application alone will more than offset the cost involved in the programme. Besides, use of this method brings about greater uniformity of soil fertility in the field, leading to maximum economic yields of crops, which could not be achieved through other methods.

Other applications of the GPS-generated grid method:

The grid generated by GPS is stored in the computer and used for site-specific evaluation and monitoring of numerous functions involved in crop production to achieve peak efficiency in farm management. Some of these areas are listed below:

– Planting variable rates of seed to maximize crop yields from the specific fertility of each grid section.

– The GPS-guided grid system helps to apply variable rates of herbicides and pesticides to achieve maximum control of weeds and pests. This not only reduces the cost of chemicals used, but also improves efficiency of pest control and protects environment.

– This enables the farmer to side dress application of fertilizers at variable rates to meet the specific requirement of each grid section, thus improving fertilizer use efficiency.

– Irrigation rates are tailored to the requirement of each grid area improving water use efficiency.

– At harvest, crop yield information is recorded on a grid section basis. Solutions for differences of yield between grid sections are sought through computer analysis of all variables controlling yield of crops that are stored in the computer. Based on this, the farmer fine-tunes his or her variable rates of application of fertilizers and other impacting parameters for use in future cropping programmes.

– One other great advantage of the GPS system of farming involves the ability of the farmer to achieve greater efficiency in time control of his farm operations. This is because the GPS system enables him to operate his equipment round the clock irrespective of factors restricting visibility such as fog, darkness, or even showers. The sub-inch accuracy of GPS-based operations provides the farmer maximum efficiency with equipment operations.

In general, a farming system involves five factors (Shibusawa, 1999, 2000). These are: plant variety, field features, technology, regional infrastructure, and the motivation/intentions of the farmer. Better integration of these five factors can create a competitive farming system which suits local conditions. Precision farming uses field maps, variable-rate technologies and a decision support system. Generating the field maps is in itself an important source of information. Variable-rate technology not only increases productivity by re-organizing the three factors of technology, plants and fields, but also creates a better linkage with the regional infrastructure, e.g. by following environmental regulations. A decision support system provides the best technology, taking into account the aims and motivation of farmers as well as environmental factors. In other words, precision farming brings about an innovation in the whole system of agriculture.

Small sector precision farming:

A key point in small sector precision farming understands variability in the field. There are at least two types of variability. One is within-field variability, the other is between-field or regional variability. Within-field variability focuses on a single field, and the one plant variety being cultivated. Between-field variability considers each field as a unit on a map. We need to consider what kind of variability is involved when we consider precision farming for small farms. Whether farms are large or small, precision farming should mean improved farm management. It should give a higher economic return with a reduced environmental impact.

On a single small farm, the farmer can understand fairly well what is going on in each field. This makes possible variable-rate applications to meet site-specific requirements, using the farmer's knowledge and skills. When it comes to an area of a few dozen hectares, containing many small fields, precision farming has to coordinate diverse types of land use and many farmers with different motivations (Fig. 2).

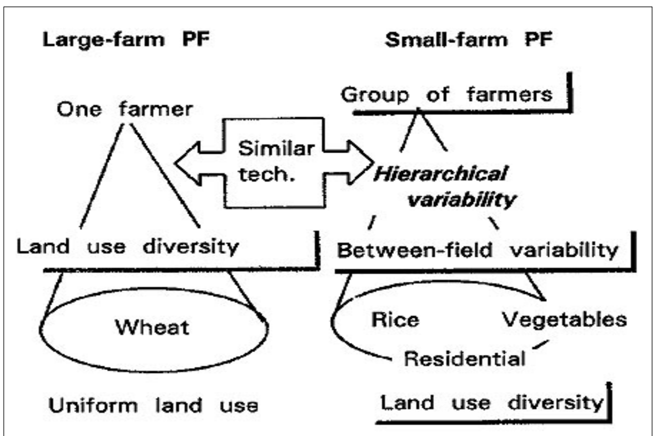

Fig. 2 : Precision farming (PF) for small farms

From the point of view of development in a rural area which includes small farms and local companies, precision farming offers the possibility of developing a new kind of industry, by fusing agriculture to various kinds of industrial activity. If the multi-functions of agriculture are re-evaluated using information-added fields, value-added space of this kind can be seen as providing new resources, such as new biological materials, open-air classrooms and green tourism.

Major challenges and future prospectus:

The priority areas for the immediate implementation of precision farming are:

- Horticultural, plantation and other high profit making crops.
- Precision mangagement of inputs like nutrients, water and other parametrers governing crop growth and yield.
- Forecasting incidence of pest and disease management in commercial crops cotton, chickpea etc. where huge quantities of pesticides are used.

Some of the approaches required to be adopted by the policy makers to promote precision farming in small farms are

- Identification of major areas for the promotion of crop specific organic farming
- To promote and provide precision farming technical backup to the farmers to develop models or pilots which can be replicated on large scale.
- Promote use of micro level irrigation system and water saving techniques
- Customization of precision farming technology to the actual Indian field condition.
- Precision farming on a regional level is one way to apply this approach to small-farm agriculture. It may not only improve farm management, but may also promote the development of rural areas.

Authors' affiliations:
G. PRASHANTH, Division of Agricultural Engineering, University of Agricultural Sciences, G.K.V.K., BENGALURU (KARNATAKA) INDIA

REFERENCES

Iida, M., Umeda,M., Kaho, T., Lee, C.K. and Suguri, M. (1998). Measurement of Annual crops. International conference on Precision Agriculture, pp 19-22, Madison, WI.

Patil,V.C and Shanwad, U.K. (2004). Relevance of Precision farming to Indian Agriculture, Agricultural research station, University of Agricultural sciences, Raichur.

Shibusawa, S. (1999). Environmentally-friendly agriculture and mechanization trend in Japan: Prospects of precision farming in Japan. Proc. International Symposium on Farm Mechanization for Environmentally-Friendly Agriculture, Seoul, Korea. The Korean Society for Agricultural Machinery, pp. 53-80.

Shibusawa, S. (2000). Precision farming Approaches for model and control. Proceedings of the XIV Memorial CIGR World Congress, Nov. 28-Dec. 1, Tsukuba, Japan, pp. 133-141.

Singh, Anil Kumar (2003). Precision farming, IARI, New Delhi, pp. 166-174.

WEBLIOGRAPHY

http://www.tnau.ac.in/horcbe/hitechfld.swf

***