

Agri-Robotics for Sustainable Agriculture

Asmita G. Kadu¹ and Utkarsha P. Gaware²

¹Department of Agriculture Economics and Statistics Section, College of Agriculture,
Nagpur, (MS) &

² Department of Agriculture Economics, Dr. RPCAU, Pusa, Samastipur, Bihar, India

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Introduction

Robotics is playing a significant role in agricultural production and management. Modern farms are expected to produce more yields with higher quality at lower expenses in a sustainable way that is less dependent on the labor force. Agricultural robots is an effective description for autonomous machines that are able to carry out different repetitive agricultural tasks on the farm- from land preparation to harvesting – without direct human intervention. It is a promising solution for digital farming and for handling the problems of workforce shortage and declining profitability. Agricultural scientists, farmers, and growers are also facing the challenge of producing more food from less land in a sustainable way to meet the demands of the predicted 9.8 billion populations in 2050. Agricultural field robots on the other hand contribute to increasing the reliability of operations, improved soil health, and improved yield. Most of the developing countries including India facing agricultural labor shortage problem. A major portion of youths from village shifting to urban for led better life. As a result, agriculture operation gets delayed during its peak seasons due to a labor shortage. Human, animal, and Mechanical power source are utilized in agricultural operation in terms of seed bed preparation, tillage, seeding or transplanting, irrigation, intercultural operation and harvesting. Average power availability on Indian farm is about 2.02 kW/ha. Robotic automated systems with camera and GPS navigation has been tried in weeding, spraying and harvesting operations.

The main challenge to the agricultural researchers around the world to perceive sustainable agriculture by judicious use of ever limiting natural resources and prevention of environment. Robotic technology in agriculture has for various operations like seeding, planting, spraying, weeding, harvesting and post-harvest operations. Therefore, application of robotics in agriculture is a complex process, which requires expert system in dealing with variable and unstructured environment and does the intended work.

Scope of farm robots in India

Our farm equipment companies and researchers have developed a lot of small and heavy farm equipment for traditional farming needs but some kind of robotic and pneumatic mechanism are required in precision farming. If the robots are being used for weed control, that will help to reduce the herbicides usage and the produces will turn into an organic, the same way robots can be used for transplanting the seedlings to avoid intensive labor. We used to read in newspapers on few impressive innovative technologies by rural inventors i.e. electric motors can be operated remotely by cell phones, it's very helpful to farmers in summer time since the power supply is irregular. If we think advanced intelligent machines in farming, Sensors or readers and hand held PDAs are going to be great helpful in computation and accuracy in farming. There are lot of hurdles taken in the agriculture sector in all countries but specially in India. Farmers decreasing in India a daily report from the newspaper. According to Shineveramya a famous writer gave a report mentioning that the "Farmers are eyes of our country. They are great men who provide food for us but now a day's farmers are reducing more in number. Many are leaving the farming profession by telling some repeated common sentences that it is no longer profitable and none want to get losses and it is becoming risky day by day. So many disadvantages. Also the youngsters are not interested in that. So they are ready to work in construction companies and not in farmland.



Importance of Robotics in Agriculture

As agricultural robots have already entered into farming sector, there would be a mobilization in farming too. The agricultural robots also help in the plantation process and

also in the process of weed removal. This would help in the reduction of usage of pesticides which would, in turn, help the environment from getting polluted due to harmful chemicals. Due to the introduction of agriculture robot; there would be less labour required an individual can plan and implement the operations of farm by himself without depending on the availability of labour. The introduction of the motors which can be operated electrically by using remote is also very helpful mainly in the summers when the water would be inadequate. Sensors and the PDAs which are handheld are going to help the farmers in a drastic way in terms of computation and also accurate in the operations of agriculture. The workers on the farm will be paid very little wages when compared to the labour which is involved in the construction. These agricultural robots will decrease the requirement of manpower and thereby reduces the operating cost of the farm. The suicidal news of the farmers will be greatly reduced as the farmer will be able to work on his own and due to the improvement in technology, he can also decide what type of crop he has to grow and how to market it.

Farming Action with Robotics

Farming is the main source for the food and automation in agriculture is increasing the strength of it. In the coming five to six years, the use of agricultural robots and drones are estimated to increase by \$30 billion. There are many real issues in the agriculture of the present day. The farming methods which are followed traditionally will make it hard to meet the efficiencies which are required by the present trend of the market. The farmers who are part of the countries which are already developed have been suffering due to the unavailability of the workforce. The development in the farming which is automated is used as an attempt to bring the solution to all these problems with the help of robotics.

- ✚ **Nursery Planting:** - Nurseries are the places where young plants are formed from the seeds which are planted in the outdoors later. The plants in the nursery are mostly sold to the consumers and gardeners directly, but they are also a beginning of the journey of food for new crops. There is a requirement of the automation in the nursery. HETO Agro technics and harvest automation are the companies which are providing solutions for seeding, warehousing the plants which are living in greenhouses, and also potting in an automated way.
- ✚ **Crop seeding:** - The plants which give food to start their life as a seed in the agricultural field. For sowing the seeds, the traditional methods are to scatter them by



using a broadcast spreader which will be attached to a tractor. This spreader will throw many numbers of seeds all around the field, whereas the tractor helps by driving steadily and following a single path. This traditional method is not considered to be an efficient one as the seeds get wasted. Precision seeding which is done in an autonomous way will help in combining the robotics with geo-mapping. A map will be generated which gives information about the properties of soil such as the quality of soil, the density of soil, etc. at each and every point of the agricultural field. A tractor with a seeding attachment which is robotic will start placing the seeds at accurate locations and at correct depths so that every seed will get a better chance for growth.

✚ **Monitoring the Crop and giving analysis:-**It is very difficult to monitor the crops grow in the huge fields. Technologies like geo-mapping and new sensor are helping the farmers to get high level of information about the crops which they are growing. The drones and robots which are at ground level will give a way to get this data in an autonomous way. Companies which manufacture drone such as precision Hawk are offering farmers few with the packages which are a combination of robotic hardware and analysis software. This will help the farmer to take the drone into the agricultural field, start the software through a Smartphone or tablet and get a view of the crop which has been collected in real time.

Robots which are ground-based, such as BoniRob will provides the farmers will detailed observations as they would be able to get very much close to the crops. Some of these agricultural robots can also be used for several other tasks such as irrigation and weeding.

✚ **Irrigation:-**Irrigating the crops will require a lot of water in the traditional method and it is considered to be not that efficient. Precision irrigation, which is assisted by the robot will decrease the water, which is wasted by targeting a few particular plants. Robots which are ground-based will negative among the crop rows in an autonomous way and pour the water directly at the base level of every plant. The advantage of robots is that they would be able to go into the area where the other machines of agriculture could not go.

- ✚ **Crop weeding and spraying:** - Some of the robots which perform weeding will not use any chemicals. For example, RoboCrop is the one which uses the vision of a computer for the detection of plants as it will be moved by tractor. It will automatically convey water to the spaces in between the plants in order to uproot the weeds. It is not efficient to spray pesticides and killers of weed onto the agricultural fields as it will cause harm to the environment. Robots will help in this situation by providing efficient methods.



- ✚ **Thinning and Pruning:** - Thinning is a method which involves decreasing plant density in order to give every plant a better chance for growth. Pruning is a method which involves cutting off the plants back parts so that there would be an improvement of growth in them.
- ✚ **Harvesting and Picking:-**Harvesting the crops like corn, wheat and barley are a bit easy. Harvesting can be done by making use of a combine harvester which can be automated. Few more crops like soft fruits are very difficult for harvesting as they need manual skill in performing tasks. The project, called clever robots for crops which have been funded by the EU is the one which is making very good progress on a few applications of harvesting. This harvesting includes apple harvesting, sweet pepper harvesting

Advantages

- ✚ Labour can be eliminated as most of the works are done by agricultural robots. Weeding, seed transplantation, fruit picking etc. are the main works related to the farm which needs manpower and the robots can handle all these. One agricultural robot can handle the work of approximately 30 workers.

- ✚ It brings us an opportunity of self-employment for those who are unemployed and thinks the farming profession as a nightmare. Through the introduction of agricultural robots, farmers will feel self-employed as their dependency on labour decreases. The investment can be done once and the profit would be huge as the operating costs decrease.
- ✚ It is one time investment then the expenditure of the farming will drastically.
- ✚ The use of fertilizer, pesticides, insecticides, herbicides and water consumption can be reduced in very large percentage.
- ✚ It brings revolution in the farming, agriculture and cattle grazing.
- ✚ There will be a drastic increase in the production of crops. Productivity will be increased to a lot extent.
- ✚ Farming will never be an occupation which is tough and also brings youngsters into it which would thereby increase the food production of the world.
- ✚ Soil testing gives the information of the soil and that information when is taken as the intelligence this report is signaled and given to the artificial intelligence along the Robotics gives us perfect results that perhaps increases the quality and that's why farmer can decide which type of crops to grow.

Disadvantages:-

- ✚ Implementation of robotics in agriculture is very costly.
- ✚ The complexity of the farm increases and there is an equal risk if proper care is not taken by the controller.
- ✚ The labour employed to take care of the farm should be well skilled in the technology.
- ✚ The power cut problem in India would be a major nightmare for the farmers using robotic

Conclusion:

It is a report from a agriculture region Maharashtra, Andhra Pradesh and Karnataka states of India that more than 17,000 farmers have suicide and end their lives from 2006-2007. Indian farming and agriculture sector can be improved for a very large extent by the use of Robotics with smart intelligence devices and making smart robots that benefit to the agriculture sector and farming. All the researches are on and we need a good time for the establishment of the technology in the farming. The future of farmers: keeping an eye on all the process behind a



computer screen while robots do the work on the land. This is essential in order to meet the growing demand for sustainable food.

