

AMETHI'S NEXT GENERATION AGRICULTURAL LEAPFROG: LEVERAGING THE EMERGING FARM TECHNOLOGIES, PRACTICES AND MANAGEMENT

Suresh Kumar Gigoo

Rajarshi Rananjay Singh Institute of Management and Technology, Amethi,
Uttar Pradesh, India

Dileep Maurya

Rajarshi Rananjay Singh Institute of Management and Technology, Amethi,
Uttar Pradesh, India

ABSTRACT:

Agriculture has been the mainstay of India's Economy for centuries. Even now, when the world is proliferated with Technology and Science in everyday lives of people, Agriculture has stood out and displayed stoic resilience. This is because Food touches the very basic need of humans. Most of the farmers around the world are using the farming or agricultural practices based on the knowledge and experience gained over generations and generations. With Food Security increasingly threatened with millions of humans adding up every day, Agriculture in modern times has to gradually transform towards leveraging increased automation and Technology for faster yields with less resources. The paradigm shift has the potential to transform the face of our villages and cities. Amethi Region in Uttar Pradesh, Northern India, a political Super brand of Indian politics, being known for affiliation to Nehru-Gandhi dynasty and previously ruled by Royal Maharajahs of Amethi since 10th century is well poised and positioned to reap the benefits of modern Agricultural practices and be an Agricultural hub. India's stunning economic growth is not only gobbling up spaces like a giant sponge but gradually eating up the beautiful scenic lands of our villages also. Pristine vistas with rows and rows of green fields are becoming History by the day. This paper describes the various measures and methods by which Amethi can be an Agriculture leader by blending core Agriculture with modern Technology with priority to leave maximum open spaces "intact and green" for enjoyment by next generation people who are getting restricted in claustrophobic cities and towns.

Keywords: Agriculture, Land, Farming, New Generation Agri –Tech Practices, Farm Mechanization, Tower Farming, Drone Farming, Amethi Agriculture Steadfast 21.0

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1. INTRODUCTION

Agriculture is the mainstay of India's economy providing/absorbing huge number of direct and indirect jobs. Many districts in Uttar Pradesh in India are mainly driven by Agrarian/Agriculture related economy. The change being the only constant in this world, it is imperative to take the big Agricultural Leapfrog to be ready for the world where 10 billion people are living without hunger and fully nourished. India demonstrated to the world in the 1960s how to feed more people with its acclaimed Green Revolution.

District Amethi lies at the latitude 26 degrees 9' North and longitude 81 degrees 49' East at an average elevation of 101 metres from mean sea level. Area of the district is about 3063 Sq. Km. The Lay of the land is mostly level, interspersed by ravines in the neighborhood of the rivers. Gomti River is a major river which passes through the centre of the district. North side of this district is bounded by Faizabad District; South side is bounded by Pratapgarh District. West side is bounded by Barabanki District and Raibaeilly District. Amethi District of Uttar Pradesh, India is divided into 4 tehsils i.e. Amethi, Gauriganj, Musafirkhana and Tiloi. The District Headquarters is strategically located astride Lucknow-Raibaeilly-Gauriganj-Munshiganj-Sultanpur National Highway.

Further the 13 blocks of the district are Amethi, Gauriganj, Musafirkhana, Tiloi, Jagdishpur, Shukul Bazar, Bhadar, Bhetua, Jagdishpur, Shahgarh, Jamo, Singhpur and Bhadurpur. In most of these areas, the agricultural practices are a blend of traditional, traditional-modern and modern.

2. CURRENT AGRICULTURAL TRENDS IN AMETHI

The deep loamy, deep salty soils and deep fine soils in Amethi District provide rich contribution to fertile agricultural lands. Main crops grown in this district are Wheat and Rice, accounting up to 94 %, Agricultural output of the crop area/yield. Other crops include Pea, Juar, Sarso, Potato and Arhar. Horticultural crops are chiefly Mango, Guava, Onion, Cauliflower, Cabbage etc. While there exists a series of canals in the district, however, increased usage/exploitation of groundwater is a source of concern. In certain areas exploitation is reaching critical levels.

Outline

In this paper, various types of modern Agriculture methods/practices are highlighted for farmers with special focus on Amethi region.

These practices have the potential to create a vibrant dynamic ecosystem heralding in the **Agri-Tech Revolution** akin to the Green Revolution of the 1960s in India. Schematic below gives the basic issues which will be dealt with in this paper. The aim is to acquaint the readers of the potential of increased yield and quality in modern Agriculture by leveraging the Technologies and IT capabilities available. The continued convergence of diverse fields will give a big leapfrog to the agriculture in India and Amethi .

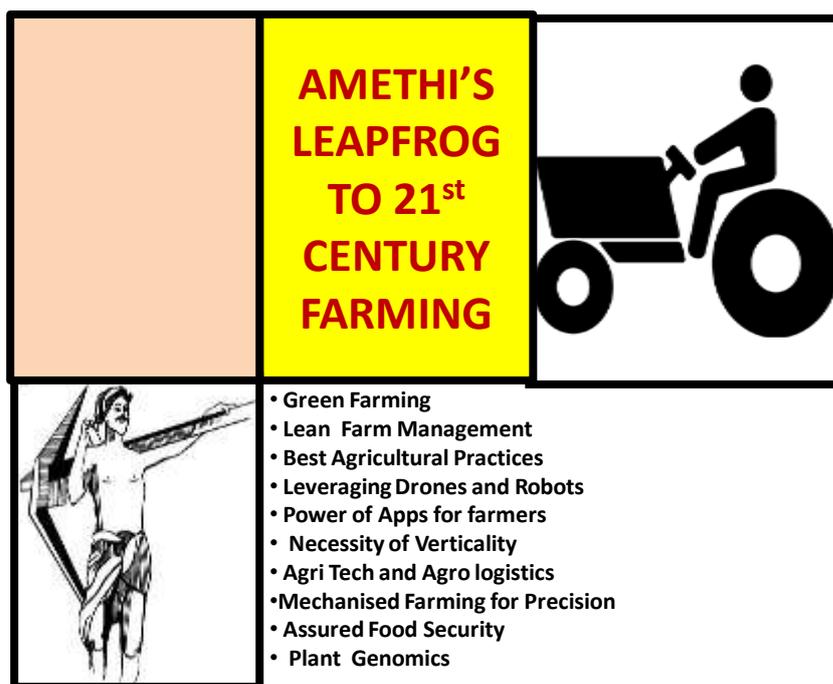


Figure 1 Beautiful Agricultural fields of Amethi District, Uttar Pradesh, India

3. MODERN AGRICULTURAL PRACTICES AND POSSIBILITIES

Following are some of the suggested new trends/emerging trends in Agriculture that have the potential to create a new **Agricultural-Tech Revolution** in crop productivity which will satiate the growing population of India's already high number of humans.

1. Drip Irrigation

Drip irrigation, also called as trickle irrigation involves dripping water at very low rates from a system of small diameter plastic pipes fitted with outlets called drippers. It is easily the most advanced and efficient irrigation system developed. Government of India has published a special document "National Mission of Sustainable Agriculture" (NMSA) which discusses about On Farm Water Management (OFWM) covering drip irrigation, micro sprinklers, mini sprinklers, portable sprinklers etc. related to this topic. Tiny country Israel has been a pioneer in being very successful in leveraging this technology which has made its many desert like areas bloom into pleasing green areas producing several horticultural and agricultural crops

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right from the late 1960s. As the time moves, farmers will have to move to this technology because of pressure from various groups to decrease water usage, lower rainfalls, increased evaporation issues, soils having become acidic or alkaline from previous times, growing technology fatigue/saturation and other factors. Precision and Smart Irrigation and Agriculture will be the key to growth of farmers yields.

In India's Karnataka state, already an Israeli company Netafim is installing a grid of drip irrigation pipes in Bagalkot district. This will cover an area of 30,000 acres in 22 villages. The project is expected to impact the lives for the better of almost 7000 farmers. Indeed a great step!

Further fillip to drip irrigation has been received recently in India when a Kolkata based company Skipper Ltd. signed a deal with an Israeli enterprise Metzerplas Cooperative Agricultural Organization for Rs. 53 crore for establishment of a plant in Hyderabad. Skipper's decision will help the regions like Amethi which are not yet penetrated by drip irrigation technologies. But the potential is awesome to achieve traction and growth. This will help Amethi to catch up on the emerging and nascent trends in Agriculture with speed. However, leap of faith has to transform across the bureaucracy for betterment of farmers and precious natural resource Water. Water is rapidly dwindling resource across the subcontinent.

Advantages which will accrue due to this technology are:-

- Efficient usage of water resources ,including, ground water resources
- Less dependence on vagaries of increasingly unpredictable rains in Amethi region due to Climate Change issues
- Faster turnover of crops and farm yields
- More organic nature of output
- Scope for increased automation/centralized control and monitoring mechanism
- Less interaction of humans with fertilizers/pesticides



Figure 2 Layout of Drip Irrigation System

2. Multi-tier farming

Indian Government has embarked on an ambitious road to double the farmer's income by the year 2022. Series of Volumes of vital document in this regard "Report of Committee on Doubling Farmers' Income Farmers incomes" gives out the ideas to prepare, plan and implement and operationalise the various methodologies in this regard. Multi-Tier Farming is a process of farming by creating various levels or various tiers so as to increase the productivity with limited resources of land. Evidence points to the fact that this method significantly enhances farm output with an intelligent usage of mix of plants/crops in limited

area. K Sankaranarayanan, P Nalayaini and C S Praharaj have given detailed findings in this regard in paper referenced at Bibliography below.

Two options of this type of Farming are feasible.

- a) In the limited area available the Plantation can be done in such a way that trees/plants/crops are “adjusted” to the needs of each other and they grow concomitantly. However, adequate planning of “combinations” and “density” factors will need to be considered properly for a long-term planning of superior and economic yields. Fig below gives the concept.
- b) In the limited area available the Plantation can be done in several tiers or stories ranging from 5 to 20 stories. Economies of supervision of manpower, automation in monitoring and leveraging of IT technologies is tangible in this option. Fig below gives the concept

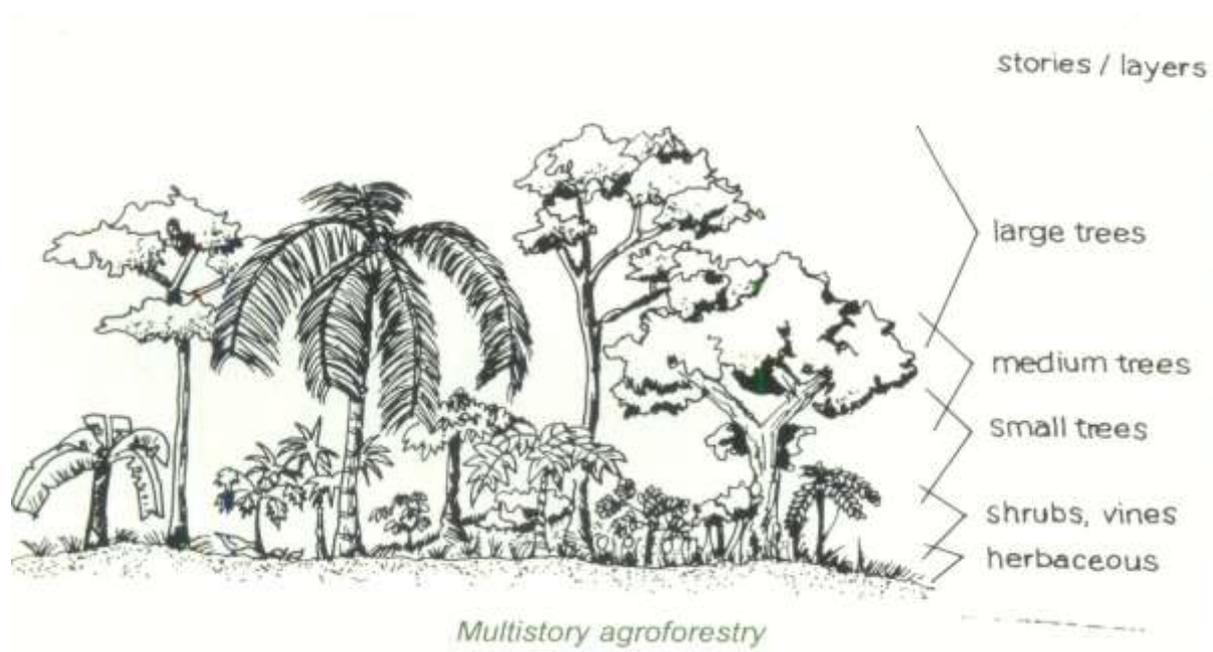


Figure 3 Model 1 of Vertical Farming leveraging the natural growth propensity and affiliation



Figure 4 Model 2 of Vertical Farming leveraging the plantation in multistoried buildings

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Advantages which will accrue in Multi-Tier Farming are:-

- Savings in the real estate in increasingly dense cities/villages/towns of Amethi District
- Better Aggregation of Marketing visibility/logistics resources
- Savings in cold chains logistics
- Aggregation of long distance transport ecosystem
- Vast tracts of land will remain green and pristine for enjoyment of people
- High profitability
- Isolation from vagaries of weather/nature
- Multi cropping possibilities even 4 in a year

Disadvantages are as follows:-

- Higher capital costs in building the infrastructure. However it shall get offset with series of Government/NGO incentive schemes
- Location to market centers may be difficult. However it can get more footfalls by being on close vicinity of Shopping Malls of the city/town
- Retraining/Reskilling/Soft Skilling of the farmers to handle the modern methods
- Higher maintenance costs

3. Tower Farming

Telecom Boom in India has been phenomenal over the last 2 decades and has been a huge success story with very high penetration of phones across the country. Today India is among the top 5 nations in phone ownership in the world. The boom has created multitudes of towers and towers across India. India has an estimated 4.5 lakh telecom towers and these are still growing in number continuously month on month. The presence of telecom related towers and related infrastructure is as unutilized /unleveraged as vast waters of Indian Ocean. These towers are crisscrossing the vast tracts of Indian subcontinent. It is proposed to boost the Agriculture of Amethi and even pan India by leveraging these towers. Understanding between Telecom and Agriculture professionals will be the basic ingredient of success. Further some tailor made/customized towers can also be installed for the needs of farmers. The Towers will be akin to the ATC Control towers at our International Airports. These Towers can be useful for Modern Farming as follows:-

- Collect the “health pattern” of crops by reading the signals emanating from grid of sensors placed in the fields in the region. Special Transceivers can be fitted into these towers at adequate and optimum heights
- Act as modern “scarecrows” to ward off the threats of rodents, neelgais and other animals by sending beeper warnings
- Provide early warning/updates to farmers through SMS/beepers about any moisture inadequacy, withering pattern etc. by reading the signal pattern from sensors
- Provide plumbing network and ensure watering as per controlled plan for the day. The Plumbing system will consist of an array of nozzles which will send water in several directions akin to thrusters of Modern fighter aircraft
- Piggyback on the slowly emerging ultra-bandwidth capabilities of 4G/5G networks as instant commands/signals execution will be easier.



Figure 5 Towers like these can be big friends of farmers in future Indian landscape

4. Drone Farming

Drones are emerging in a big way across the world. Developed as weapons targeted to hunt and kill terrorist in mountains of Afghanistan since the 1980s these machines in the sky are getting transformed to multitudes of uses day by day. Farming is one area where drones have a huge potential. Farmers in Amethi can leverage these useful devices of 21st century to boost the farm output in a big way and in an economical manner. Precision Agriculture is now a reality of this century and Amethi needs to leverage this. Furstaganj Airport in the district can be useful nodal agency to monitor the air movement of drones. Some ideas for using the drones for farming are as follows:-

- Targeted spray of seeds, fertilizer and nutrients in a particular geographic region.
- Collect farm surveillance on sustained basis and communicate vital statistics to farmers through SMS/E mail on every day basis.
- Give timely warning of met conditions to the farmer.
- Maintain the video footage of ground conditions/images for the rabi and kharif season.
- Monitor the soil health by remote soil mapping and generate Soil Health card on regular basis.
- Analyze and timely warn farmers on any breach in Land Integrity in the area.
- Timely warning about floods and water ingress in fields.



Figure 6 Image of a Drone at work in an Agricultural farm

5. Robot Farming

Next level of Smart Agriculture is almost arriving here now. The robots are going to create a huge impact in Farm landscape. Agricultural Robotics is emerging as a new field focused to leverage automation for the farmers and fishermen. Soon the landscape in Amethi will be populated with various designs and forms of robots (but not like Star Wars movies types). These will be as ubiquitous as numerous motorcyclists on Amethi's roads. These new friends of the farmers can be fruitful for 24 x 7 surveillance of farm fields, picking of mangos/guavas and other fruits from trees and other tasks like weed control, harvesting and packing to markets. They will also be deployed for the purpose of mowing, pruning, seeding, spraying and other such chores.



Figure 7 Image of a series of robots at work in an Agricultural farm

6. Greenhouse farming

A greenhouse (also called a glasshouse) is a structure with walls and roof made chiefly of transparent material, such as glass, in which plants requiring regulated climatic conditions are grown. A more scientific definition is “a covered structure that protects the plants from extensive external climate conditions and diseases, creates optimal growth microenvironment, and offers a flexible solution for sustainable and efficient year-round cultivation

Green house is a way of new farming which protects the environment as well as can create a big boost to Amethi's agriculture.

Another big plus for greenhouse farming is that it allows people to take advantage of vertical space. In a normal farming environment, the growing area is generally a flat expanse, but this isn't true when farming in greenhouses. Many farmers will have plants sitting in shelves or hanging from the ceilings, and this sometimes allows the farmer to pack more plants in an acre than usual



Figure 8 Image of a Greenhouse Farming

Advantages which will accrue due to this technology are:-

- Increased reliability of crop production
- Mostly suited for vegetables and fruits
- Less seasonality aspect
- Less water requirement

7. Organic Farming

As a result of huge impact of chemicals/fertilizers and pesticides, farm yields exploded at a whopping rate in the decades after the Green Revolution. However there has been a big collateral damage. The quality of soil has severely deteriorated. Crops are now suffering from several diseases. Organic Farming is considered the natural way of producing crops. Organic Farming can be understood as an agriculture method that does not make use of fertilizers and pesticides. It thrives on the benefits from the recycling of natural products; green manure, biological pest control methods and special cultivation technique are employed to maintain soil productivity.

Organic Farming is a production system that sustains the health of soil, Ecosystem and soil. It combines traditional farming Innovation and technology to agricultural production. Demand for organic crops and produce is growing steadily by the day and is also fuelled by the Indian yoga gurus and godmen. Amethi is well positioned to ride on this boom being located close to the amla orchards.



Figure 9 Image of an Organic Farm

8. Solar Farming

Middle East countries achieved huge prosperity from the 1970s onwards due to the “liquid gold” i.e. oil. But times are changing fast. Shale Gas is rapidly reducing the dependence on oil. However, the new oil is going to be of different kind. More abundant and less a source of wars. Energy from the sun is going to change the dynamics now. India is well positioned to take a leap forward with solar energy. In this regard India is emerging as a leader of Solar favorable countries. International Solar Alliance (ISA) is a coalition of solar resource rich countries lying fully or partially between the Tropic of Cancer and the Tropic of Capricorn to specifically address energy needs by harnessing solar energy. As an action- oriented organization one of the three programs of ISA namely “Scaling up solar applications for agricultural use” will be a key driver of change in “Green Agriculture”. ISA is conceived as a coalition of solar resource rich countries to address their special energy needs and will provide a platform to collaborate on addressing the identified gaps through a common, agreed approach. The Government of India has set a target of producing 100 GW from Solar energy by 2022,



Figure 10 Solar pump at work in an Indian field

9. Agricultural Mechanization

Govt of India has published an elaborate document titled “Sub Mission on Agricultural Mechanization Operational Guidelines (Twelfth Five Year Plan) 2014 (Revised in 2016-17). The document gives the gamut of information, incentives, facilities, testing methods, promotion methods, training, testing, demonstrations for enabling more Farm Mechanization. It gives the requirement of Agricultural machines for the purpose of Land development, tillage and seed bed preparation as also for sowing, planting, reaping and digging equipment. Equipment covered includes self-propelled, specialized and towed equipment for farmers help in boosting the farm yields and saving manhours. This document must be leveraged effectively by the farmers in Amethi region to take the Agriculture to next level of maturity and technologically driven efficiency and competitiveness. Several agricultural implements and farm management systems and accessories have been developed by India's leading companies like Mahindra, Swaraj, Sonalika etc. for better optimization for farmers. Amethi's farmers need to embrace these in a big way. These equipment include implements like Harvestors, shredders, cane thumpers, fertilizer sprayers, rice transplanters, rotavators, gyrovators, disc ploughs, rotary tillers, disc ridgers, sub soilers etc.



Figure 11 Some special and common Farm equipment

10. Establishment of Seed Testing Laboratory at Amethi

Amethi Region is a huge agricultural hub catering to needs of large number of farmers. Being the nerve centre of Agriculture, it is imperative to have one District level Seed Testing Laboratory for the benefit of farmers. This way the farmers will be able to produce the farm yields in better quality and quantity. Locating them in places like Lucknow, Kanpur or Varanasi is not helpful and needs to change with the requirement of the current times. The sub optimal seeds used by Amethi's farmers are clearly visible with their quality and look of being famished and inadequate.

11. Seed Bank for Posterity of Farming

Amethi needs to take a big leap towards being huge Agricultural Centre. It needs to invest in the new emerging field of genomics especially Plant genomics. There is a genuine need to have a Seed bank for farmers as it is a pressing need and will help Amethi gain its historic stature. The Seed Bank will store seeds of different crops and rare plant species and store them even for future use. Seed banks will help to preserve and protect biodiversity. Amethi is an appropriate place for this as it is less vulnerable to disasters. The Seed Bank will act as an insurance against war, natural disasters or other kinds of unforeseen events.

12. Conservation Agriculture

Food and Agriculture Organization of the United Nations (FAO) defines Conservation Agriculture “as a way of managing agro-ecosystems to achieve higher, sustained productivity, increased profits and food security while enhancing the environment. This is achieved through improved management and application of three key principles. These are minimum soil disturbance, Permanent soil cover AND Diversified crop associations and rotations.” Together, these principles form an integrated system of farming. For full benefits, all three

principles must be applied at the same time and in conjunction with other good agronomic practices such as timely planting, effective weed control and integrated pest and disease management. Amethi Region can be a good testbed to form the best practices in Conservation Agriculture having a fairly knowledgeable body of farmers. Regular interactive and immersive experiences will indeed go a long way to boost sustainable and biologically friendly Farm practices.

13. Six Sigma in Farming

Series of Rewards and Incentives for boosting farm quality and farm quantity is essential to attack the wastages all across the food production ecosystem/chain. Adoption of Six Sigma philosophy from Industry will help farmers to use the power of technology and Farm practices to progress to Lean Management in Farming. Compliance to specifications of FSSAI Standards (or better/stricter) must be enforced at all levels with automated surveillance and random checks. Robots will be more effective and fair and get less fatigued to human checks. This methodology can be effective to stop the “defective” seeds, grains and vegetables. Imagine the leap in quantity when only 3.4 seeds in a million seeds will be “defective”. The jump in quality will be truly phenomenal.

14. Android/IT/IOT Leveraging

Farmers of Amethi region are now rapidly becoming IT and mobile savvy. They are already leveraging the various apps developed in the country. However, there is a need to get into the apps in more detail to get the best out of them. In this respect there are several apps which can be leveraged. Recently launched app UMANG (Unified Mobile Application for New-age Governance) is envisaged to make e-governance 'mobile first'. It is developed by Ministry of Electronics and Information Technology (MeitY) and National e-Governance Division (NeGD). By this app maximum Government departments are aggregated into a one stop shop style single platform to provide effective services to citizens including farmers. The app has several features useful for farmers including on Farm Mechanisation, Crop Insurance and Soil health cards. The aspects covered include Agro Advisory, Weather forecast, details of pesticide, seed and farm machinery dealers. Besides this several apps like Kisan Suvidha, Farm-o-pedia etc. are also helpful. Amethi Farmers require practice and training to use these for their regular needs. Similarly BHIM app may also be leveraged by farmers for increasing cashless transactions to save time and efforts in under banked and financially non inclusive remote areas. After E-Banking, M-Banking now E-Agriculture and M-Agriculture terms are going to get more prominence in people mindscape by virtue of powering the fields of IOT in a big way in future. IOT will create a cross technologies platform for the benefit of accessing various information for farmers.

15. Google Earth Farming/Remote Imaging Farming

Google Earth is a popular application developed by Google. The potential of this application is huge. Farmers have only used it sub optimally so far. The application can be useful in several ways. It can help the precise area calculations of farmers land and water bodies in the land, precision mapping and study of variances/anomalies withheld land records. It can also be helpful for “notional” or “real” zoning. The application can also be helpful for mapping typical areas like dead grounds, broken grounds, areas with thick vegetations. Further applications possible by Google Earth include aspects like soil health indexation, crop health pattern study, crop density variances, land use assessment, Accuracy of Land assessment and change detection study. Satellite Imagery and Technology/software by other agencies can also be helpful for farmers. Companies like Satsure in India are playing pioneer role in amalgamating and integrating satellite imaging, analytics and Big data for prediction of crop

yields and Trend Analysis. Farmers in Amethi need to study the advantages of these emerging 21st century Farm practices of Remote farming.

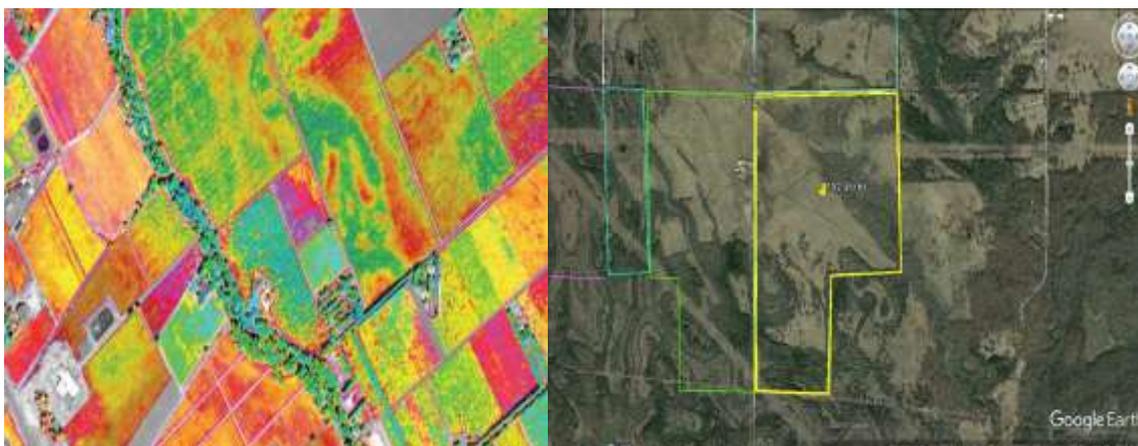


Figure 12 Leveraging of capabilities of Google Earth and Satellite imagery/Remote Imaging

16. Modern Agri Logistics

While the hard work and toil of the farmers is producing millions of tonnes in food output there are many wastages/slippages/pilferages happening in the system. There is a need to have new generation Smart 21st century Agri Logistics with effective 24 x 7 visible real time ERP systems in place for farmers. This will improve efficiency, reduce downtimes, faster turnarounds and improve capacity and throughput at all levels. A full switch to Smart Automated silos and Smart warehouses with associated paraphernalia for storage of grains is necessary. Usage of Solar power in these buildings will help reduce overheads to a large extent. Dedicated Agricultural trains called “Kissan ki Jeet Express” must be given priority on various trunk routes by Indian railways .Gauriganj must be made as the central hub with spokes in various important towns like Jais, Fursatganj, Musafirkhana, Dhamour etc. for transporting food across india. Good Quality roads must be able to push to deep interiors of villages faster. Traffic Choke Points must be removed for smooth transportation of grains pan India. Agricultural themed Supply chains must be given host of incentives till the maturity of logistics reaches to a DHL, Adani, VRL Logistics, TCI, Fed Ex etc. Export Potential will definitely expand once above measures are deeply implemented. Therefore, last mile containers movement must be speedily addressed. Extensive usage of RFID may be used for smoother operations. Private entrepreneurship Schemes(PEGs) and Private Warehousing Schemes(PWSs) must be encouraged by FCI with certain threshold business guarantee.





Figure 12 Modern Silos and transport provide good Agri Logistics

4. CONCLUSION

The world of 21st century is a world of convergence whereby all the technologies including Solar Energy, Drones, Telecom, Robotics, sensors, Genomics, Surveillance, Internet of Things(IOT) and state-of-the-art logistics and supply chains are increasingly helping mankind to achieve economies of scale in quantity and quality across vast geographic regions. Amethi is blessed with superb geography and strategic location. Farmers of Amethi can now leapfrog and reboot to the future of Agriculture which will be create an AgriTech Revolution. The same can be christened as “**Amethi Agriculture Steadfast 21.0**” due to the proven track record of resilience of Amethi’s farmers over the centuries.

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This paper is dedicated to the efforts of farmers of Amethi and with further extension to all farmers of India. The authors express sincere thanks to all the farmers of our great nation for doing tireless, unsung, tough, sacrificing, great work in keeping India adequately fed .Their valuable contribution is respected and appreciated. We hope that our farmers get the awards, incentives, benefits and profuse thankfulness always in future.

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