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Contents

Management Practices To Improve Productivity And Quality In Cucurbitaceous Crops

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ABSTRACT

Cucurbitaceous crops also known as cucurbits form an important and a big group of vegetable crops cultivated in the country. India is found to be the centre of origin of many cucurbitaceous crops. It is important to pay attention on constraints for seed production of cucurbits to improve productivity and quality. The production, productivity and quality of cucurbitaceous crops can be improved by adopting good quality seeds and planting materials of improved varieties and hybrids, improved cultural practices or technologies, proper plant protection methods, integrated pest management and lastly but not the least, better pre and post harvest management. However, popularization of the developed technologies amongst the small and marginal farmers continues to be a challenge even today. It is the need of the hour that the developmental agencies, NGOs as well as the research organizations promote adaptation of technologies among farmers.

1. Introduction

Cucurbits form an important and a big group of vegetable crops cultivated extensively in the country. It forms nearly 6 percent of the total vegetable production (Rai et al., 2008). Cucurbits are also important for their nutritional value (Kim et al., 2012, Achu et al., 2005). They are not only rich in proteins, antioxidants, vitamins such as carotenes, but also low on fatty acids and calories. This group consists of a wide range of vegetables used as salads, for cooking and pickling. They are used as desert fruits also. Pumpkin (Cucurbita moschata) is being largely grown in the states of Orrisa, Assam, Punjab and Rajasthan, bottlegourd (Lagenaria siceraria) growing areas are Uttar Pradesh, Assam, Gujarat, Punjab, Haryana and Rajasthan, ridge gourd (Luffa acutangula) and sponge gourd (Luffa cylindrica) growing areas are more confined to Assam, Punjab, UP and Bihar. The quality and productivity of cucurbits can be improved by adopting good quality seeds and planting materials of improved varieties and hybrids, improved cultural practices or technologies, proper plant protection methods and better pre and post harvest management. But successful implementation of above-mentioned strategies can only be achieved through understanding the limitation of production and quality. This article briefly discusses the limitation and methods to improve production and quality of cucurbits.

2. Limitations In Production And Quality

Productivity and quality of the cucurbits is limited by ecological factors including both, biotic and abiotic factors (Dong et al., 2016, Rai et al., 2008), and socio-economic factors (Rai et al., 2008). Few limitations are listed below-

Ecological Factors

- Scarcity of water
- Diseases and pests
- Fragmentation of land holding
- Climatic variability
- Environmental pollution
- Natural Disaster
- Human-wildlife conflict

Socio-economic Factors

- Weak agro based industry
- Weak research- extension- farmers linkages
- Inadequate supply of quality seeds and planting materials of improved cultivars
- Scarcity of trained human resource
- Strong hold of middlemen in marketing
- Expensive hybrid seeds
- Farming system

Each species usually responds differently to each limiting factor, hence each limitation needs to be explored to study its impacts on crop quality and productivity. Knowledge acquired through such research can be used in overcoming such limitations.

3. Methods To Improve Productivity And Quality

a. Introduction Of New Germplasm

Genetic resources are basic foundation block in any crop improvement program. These include wild species related to cultivated crop plants that are mainly used by tribal and cultigens like land races, primitive cultivars, obsolete cultivars and improved cultivars including indigenous varieties (Moose and Mumm 2008, Khush 2001). India is not only rich in the genetic resources because of its wide range of ecosystem, agroclimate and tribal and ethnic diversification, but it is also the center of origin of many cucurbits (McCreight et al., 2013, Staub et al., 1997). This large genetic pool can help in development of new crops, which are adaptable to changing practices and environment. A systematic evaluation of these crops is needed to introduce them in agricultural practices of the country.

b. Heterosis Breeding

The exploitation of hybrid vigour depends largely on the availability of specific combinations of genetically distinct lines, which in the form of first generation hybrid gives superior performance than the individual genotypes (Sureja et al., 2006). The cost of production of F1 in these crops is comparatively less as being monoecious in nature and gynoecious lines available in cucumber (Cucumis sativus), a single fruit contains a large number of seeds and also the seed rate is less (Robinson 2000). Cucurbits show wide range of sex forms and sex expressions (Keilkowska 2013, Grumet and Taft 2011) and most importantly they do not show inbreeding depression, so a conscious effort is needed to accelerate the pace of hybrid research and increase the area under hybrids of cucurbits.

c. Organic Farming

In India, organic manures have been traditionally used in growing cucurbits for improving soil health, organic carbon and micronutrients (Ramesh et al., 2010). With the use of chemical fertilizers, fungicides, insecticides and herbicides the production has increased manifold, but over the years it has destroyed many naturally occurring effective biological control agents and also resistance of pests to chemical pesticides is on the rise (Geiger et al., 2010). Sustainable yield by following organic farming is still a question mark but a combination of organic manures and chemical fertilizers is a good option to improve yield as well as quality (Rigby and Caceres 2001), besides it will boost the export of cucurbits.

d. Biotechnology

Although for the past few years, research has been going on but now more concerted effort is needed. Embryo culture has been used to produce interspecific hybrid plants in watermelon (Zhang et al., 2014). In order to produce homozygous diploid plants, anther culture technique has been used in cucurbits (Dong et al., 2016). There is a need to develop resistant varieties of cucurbitaceous crops against diseases as well as insect pests (Gaba et al., 2014). The works on transgenic cucurbits especially against abiotic stress need to be strengthened (Koyro 2012, Migocka and Papierniak 2011).

e. Off- Season And Protected Cultivation

The off season nursery of cucurbits can be raised during December and January in low cost poly house and seedlings can be transplanted in the first week of February in the prepared field when danger of frost is over. By adopting this technique, cucurbitaceous crops can be grown one to one and a half months in advance than the normal method of direct sowing in the field and it gives a good price by selling the produce in off-season. Protected cultivation of cucurbits is a good option for good quality as well as high yield of produce in off-season. Low cost poly houses can be designed and used only for the raising of nursery during off-season also.

f. Integrated Pest Management

Cucurbits are vulnerable to leaf miner, cucumber mosaic virus, red pumpkin beetle, fruit fly and Pernospora sp. damage (Keinath et al., 2017), so it is now even more essential to study the pest problems and pest risk assessment in changing environment of cropping system and global market. The knowledge of insect pests, pathogens, nematodes, weeds and plant stress is of paramount importance and should be undertaken on large scale. Besides, pesticide residue is nowadays a major problem (Nishant and Upadhyay 2016). Integrated pest management is a system approach, which is location and crop specific (Krishna et al., 2017, Stenberg 2017), hence, knowledge of pest problems, their economic status, life history and related issues should be flagged for the development of IPM in cucurbits. The major insects, pathogens and nematodes should be managed by developing IPM, which includes various practices for that habitat; socio economic factors should be taken into consideration. The management practices like soil tillage, crop husbandry (timely sowing, spacing, healthy seeds, balanced fertilizers, hygiene, timely harvesting, well timed irrigation, and plant health), application of bio pesticides and finally a judicious application of chemical pesticides as per need are found to be of utmost importance.

g. Post Harvest Management And Marketing Strategies

The major contributory factors for losses during transit, storage and marketing are improper harvesting and handling practices, market gluts and improper market infrastructure. Nearly 30- 60% loss is reported in cucurbits during the post harvest process (Kitinoja et al., 2011). Following aspects should be taken care of in post harvest management of Cucurbits:

1. Care should be taken at the time of harvesting. 2. Pesticide residue management and new variety development will add value to the produce. 3. Pickling cucumber and bitter gourd are highly in demand for the processing purpose. 4. Efforts should be made to reduce post harvest losses by developing more varieties with longer shelf life and processing qualities. 5. Insurance of crops of the farmers 6. Controlling the price of produce 7. Development of co-operative institutions 8. Encouragement of the farmers to adopt post harvest management practices. 9. Transfer of technologies and educating the farmers about the benefits of proper post harvest technologies 10. Development of suitable varieties for processing and export 11. Awareness for quality produce in cucurbits. 12. Freight subsidy for export. 13. Long term and consistent export policy 14. Identification of new market potential 15. For the proper

implementation of the strategies aimed at improving the quality and productivity and minimization of post harvest losses the developmental agencies and the research organizations should come forward and work together in synergy.

4. Conclusion

Cucurbits are important for food security, nutrition as well as economic well being of farmers. In the changing ecological and socio-economic scenario, there is no one-step solution to improve the quality and productivity of cucurbits, inclusion of scientific and social understanding both are required. However, both approaches need long-term policy integration with a key objective of sustainable farming. With changing climate, threats of diseases and pests are ever increasing hence the research must focus on finding natural and innovative solutions. Inclusion of more and more variety will significantly reduce the crop damage due to diseases. Switching to integrated pest management has now been well accepted in farming, however, implementation is still lacking. Traditional Ecological Knowledge needs to be further explored and implemented at large scale after careful evaluation. Post harvest management will play a crucial role in reducing post harvest losses and increasing economic benefits. Another area to focus on is integration of industries to develop more variety of products utilizing different parts of the crops.

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Robotics: The Future For Farm Mechanization

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A B S T R A C T

Farming in the near future has to produce more food and fibre to feed a growing population with a smaller rural labor force and contribute to overall development of countries. Robotics in agriculture, the sustainable food production method has the potential to improve competitiveness and increase crop productivity compared to the current methods, thus becoming an increasingly active area of research. In this paper, robotics and its application in agricultural fields are discussed, that helped to increase the accuracy and precision in agriculture.

Key words – robots, agriculture, application, drawbacks

1. Introduction

World's population increases, so do the demand for food and to congregate the mounting population, farmers must adopt advanced technology at the production of all crops. One such technology is robotics where, robots must be utilized to accomplish most tasks efficiently in intensive agriculture. The word "robot", made its way into English from Czech in the 1920s, means slave or forced labor and it was pioneered by Karel Capek through a play, Rossum's Universal Robots (R.U.R.), which anglicized "robot" as a man-like machine. A robot is a reprogrammable, multifunctional manipulator designed to move material, parts, tools or specialized devices through variable programmed motions for the performance of a variety of tasks (Gupta and Arora, 2009)

The idea of robotic agriculture, involves industrial style of farming where everything was known before hand and the machines could work entirely in predefined ways. The robots, an autonomous machine must exhibit sensible behavior in recognized contexts and should have enough intelligence embedded within them to behave sensibly for long periods of time, unattended, in a semi-natural environment, whilst carrying out a useful task (Blackmore et al., 2004).

The robotics, study of robots, in real time is spreading very fast all over the world in every day to cover further domains, as the opportunity of replacing a robot in place of human as an operator provides effective solutions with return of our own investment in less time. Conventional techniques in agriculture depend on human power for lifting, pushing, dragging, weeding, fruit picking. Further, humans are prone to work in dangerous and hazards environment when they are spraying chemicals and pesticides it may create a problems to farmers. Consequently, robotics comes in use, when the duties, that need to be performed, are potentially harmful for the safety or the health of the workers, or when more dangerous issues are granted. In the case of automated agriculture, above said problems are exemplified and robots can work restlessly in all environments (Kamalesh et al., 2014).

Laws of robotics

Machine ethics should be followed while construct of robots as given by Asimov, 1984. Ethics involves three laws of robotics in a way, how intelligent machines, rather than human beings, should behave.

- **Law 1:** A robot may not injure a human being, or, through inaction, allow a human being to come to harm.

- **Law 2:** A robot must obey the orders given it by human beings except where such orders would conflict with the First Law.

- **Law 3:** A robot must protect its own existence as long as such protection does not conflict with the First or Second Law.

History of Agricultural robotics

The ancient people used simple tools such as spears, nets and various other traps to catch their prey during the Stone Age period (2,000,000-3500 BCE). Subsequently, in the period between 2500 BCE to 1750 AD, the use of animals had been prominent in agriculture. Archeologists believed that dogs were the first animals to be domesticated. Dogs helped early people by hunting and also kept rats and other rodents from eating the crops. The use of animals in farming and the continued use of tools allowed farmers to cultivate more land and also increased the size of many farms. Further, the caschrom, a long pick with a cross-handle and projecting foot-piece used for digging stony ground, helped farmers to tear up the soil and flip the dirt to either side. Then, the Agricultural Revolution lasted from about 1750-1900 A.D., when America changed the world drastically. The main cause of the Agricultural Revolution was the introduction of machines. A well-known machine introduced during this time was cotton gin, one of the first machines used in agriculture. This machine was able to quickly separate cotton seed from cotton fibers, creating up to fifty pounds of cleaned cotton a day, the equivalent of hundreds of man-hours. This led the way to our modern agricultural machines. Another major change that occurred during the

Agricultural Revolution was the creation of the United States Department of Agriculture, or the USDA. The research done by the USDA today helped to create robots and other technological improvements for American farms. During this time period of nineteenth and twentieth century's, some of the modern agricultural machines, such as the lawnmower and the tractor were invented and used worldwide. The first Deere, Tate & Gould factory were built, involved in making tractors during this era and these machines grown to become the presently known modern agricultural robots.

Timeline exploring the history of machinery into the field

Agricultural robots are part of an overall automated process for every type of human endeavor. Robots are being used more widely than expected in a variety of sectors, and the trend is likely to continue with robotics becoming as ubiquitous as computer technology over the next 15 years. It is also believed that the robots, esp. in agriculture facilitate to perform tasks that require low cost with greater accuracy and reliability. However, implementation of robotic technology took a protracted way in field of agriculture (Table 1).

Table 1: Chronological development of robots and automated machines in field of agriculture

S. No.	Period	Significance
1	1842	The first grain elevator is used in New York
2	1845 - 70	Transition from use of horses to tractors and reduction in labour cost
3	1850 – 75	Transition from hand power to mechanization esp. for threshing
4	1854	The self governed windmill was developed
5	1892	The first gas tractor was created
6	1926	The cotton stripper was created for easy harvesting
7	1945 – 55	The use of pesticides and herbicides increased
8	1959	The tomato harvester was evolved
9	1990s	The use of IT and precision technique became prevalent in agricultural field
10	1994	Satellite technology began to allow the farmers to track and plan their practices
11	2002	Yamahas industrial autonomous helicopter, the unmanned crop spraying in Japan was done
12	2011	Introduction of R-gators, the unmanned ground vehicle
13	2012	Automation in harvest with the help of agricultural robots
14	2013	Association of unmanned vehicle system international (AUVSI) released the economic impact of unmanned aircraft system used in agricultural precision system

Classification Of Robots

Robots are broadly classified based on its locomotion and the way it is controlled. Robots, based on locomotion are further classified as stationary and mobile robots.

Stationary robots: Robots cannot move from one place to another and remain stable. It works with intelligence from the place, where it is installed. Eg: e-nose, e-tongue, grain elevators etc.

Mobile Robots: Robots that can move from one place to another with the predefined pathway. These robots are further divided based on the way and the environment it is designed to work. They are categorized as following

a. Land based robots: The robots that are designed to work on land

1. Wheeled robots: Movement of robots on wheels. Different types of wheels viz., standard, orientable, ball and omni are utilized for constructing robots. Standard wheels allow the robot to move in the forward direction while an orientable wheel helps the robot to move in both forward and backward directions. Robots with ball wheels stirs and en-routes multidirectional movements. The strength of omni wheel is the enhanced maneuverability in congested environment.

2. Legged robots: Locomotion of robots depends upon the orientation of legs.

3. Tracked robots: Tracks facilitate robots motion on terrains, hard and uneven surfaces.

b. Aquatic robots: The robots that are designed to work in water Eg: autonomous underwater vehicle

c. Flying robots: The robots that are designed even to work in air Eg: drones

d. Hybrid/Wheel-legged Robots: Wheel-legged robots are irregular robots with multiple functions. Wheels can make your robot move faster, are easier to design and build. Legged robots on the other hand are excellent on uneven surfaces and rough terrain. E.g. jumping or hoping robots.

The key and main components of robots are given in table 2, which mainly helps for the functioning of autonomous vehicle.

S. No.	Components	Functions
1	**Mechanical linkage**	Different type of mechanical assembly which contains gears, wheels, arms, etc. is known as mechanical linkage
2	**Sensors**	The sensors are the transducers which convert one form of energy into another form ex. light sensors, touch sensors, US sensors, IR sensors, etc.
3	**Actuators**	The devices which help to produce connectivity between electronics circuits and mechanical assembly are known as actuators
4	**Transmissions**	A conductor for transmitting optical or electrical signals or electric power
5	**Stepper Motors**	Stepper motors are used to obtain either rotational motion or step motion to the mechanical assembly of the robot
6	**Power conversion unit**	This is the power supply of the robot either mains supply or batteries
7	**User interface and software**	This is the controlling software section of the robotic anatomy that controls the overall working of robot to carry out a particular task

2. Application Of Robotics In Agriculture

The robotic approach may not be economically justifiable in many broad acre crops but will certainly be more attractive in high value crops where a smart machine can replace expensive repetitive labour. The application of this technology in crop production could reduce the production cycle to three stages: seeding, plant care and (selective) harvesting and thus the potentiality of applying autonomous robotic vehicles compared to conventional systems are discussed below.1

Ploughing: Ploughing is one of the most important primary cultivation processes and had been carried out since the start of civilization. It is effectively the inversion or mixing of topsoil to prepare a suitable seed bed. It also has the ability to bury surface crop residues and control weeds. Earlier, ploughing was performed with the help of a man and pair of bullocks, subsequently, replaced by manned tractors which reduced the man power. Further, to improve the accuracy man less tractors came into existence that failed to embrace the complexity of real world. To overcome this difficulty, automated compact robot can be made to obtain specific results. Dattatraya et al., 2014 and Zanwar and Kokate, 2012 assembled an autonomous system for cultivating ploughed land that required less power. The developed robotic system was an electromechanical and artificial agent steered by DC motor that had four wheels. The infrared sensor used detected the obstacles in the path and also sensed turning position of vehicle at end of land. The machine was controlled remotely and solar panel was used to charge DC battery. It was reported that the farm was successfully cultivated by the machine, depending on the crop considering particular rows & specific columns. A meticulous study was done on different types of robots by Kamalesh et al., 2014 to increase the efficiency and precision in agriculture fields. They expressed that cultivators were interested and satisfied to use tested robots in agricultural fields for ploughing, cultivating and leveling to increase the productivity rate.

Planting: Planting method includes broadcasting, seed drilling, row planting etc., selection of these methods should be based on planting equipment, time and labor availability, seeding costs, planting date opportunity, weather, crop usage and yield goals, and stand establishment risks associated with each method. In addition, calibration of planting equipment is critical to get the correct number of seeds in the soil. Robotics, now, had paved a way to overcome the said risks. Chavan et al., 2015 designed enhanced robotic system for seeds sowing in pre defined row spacing ploughed lands and observed that this system effectively reduced the labour costs and also placed the seeds in a uniform manner. Shiva Prasad et al., 2014 also designed system for seeding, fertilizing and soil ph, temperature, moisture, humidity checking. The designed system involves robot navigation to the destination successfully, performed operation with no hurdles, thus, was reported very useful for the farmers who were intended to do agriculture activity.

Grafting: Despite the labor intensive nature, manual grafting has been used as the predominant method worldwide. Grafting speed and success rate are strongly affected by plant species, grafting methods and operators. Recently, automated grafting or grafting robots gained importance against labor management issues during period of seasonal demands. Chang et al., 2012 compared the hand and robotic tube grafting in sweet pepper and indicated that the survival percentage of both the methods were on par with each other. In addition, they observed that the enhanced grafting speed recorded with robotic tube grafting. Nishiura et al., 1995 constructed a grafting robot to perform the “plug-in method” on the basis of the seedling characteristics and the structure and physical properties inside the stem. It had been demonstrated that the proposed technique of cutting vegetative materials using an ultrasonic level vibrating blade can reduce the damage to the vegetative tissue.

Irrigation and watering: Irrigation of land is a paramount in farming and it needs continuous monitoring to avoid under irrigation and over irrigation. Automation in agriculture envisages monitoring and controlling the irrigation, that directly or indirectly affect the growth of crops. Chauhan et al., 2014 introduced the technology that would monitor the soil moisture and decides the duration of irrigation for maintaining the moisture at an optimum level to harvest maximum crop output. A completely autonomous system for watering potted plants was presented and evaluated by plotting a graph between the number of plants watered and the time required by the mobile robot. The evaluation indicated that the system was highly cost-effective and efficient in terms of time, to perform the watering operation (Hema et al., 2012).

Crop scouting: Unmanned aerial vehicles (UAVS), also known as drones, are aircraft either controlled by 'pilots' from the ground or increasingly, autonomously following a pre-programmed mission. Zhang et al. (2014) examined the feasibility of applying unmanned aerial vehicle acquired images for monitoring crop conditions based on the actual requests from producers. The results suggested that it is plausible to obtain images and process them in a timely fashion for precision agriculture applications. However, due to current costs and operational logistics the application is still in its infancy stage.

Weeding: Weeds have a controversial nature. But to the agriculturist, they are plants that need to be controlled, in an economical and practical way, in order to produce food, feed, and fiber for humans and animals. Removal of weeds also involves many energy-intensive methods. But now smarter and more environmentally friendly approaches are available for eradicating weeds. One such approach is utilization of robots in weeding. Robots performs the elementary functions of farming involvesharvesting, spraying, seeding, weeding, grading etc. and gradually appears advantageous to increase productivity, improve application accuracy and enhance handling safety (Sani, 2012). The autonomous assembly was developed for weed control system in ploughed land with no intervention of man power. The assembly consisted of two different mechanisms that detected weeds and obstacles present in path of the vehicle by color and infrared sensor respectively. The high speed of the weed removal operation ensured the scope for further expansion (Kulkarni and Deshmukh, 2013).

Spraying: The inhalation of chemical spraying could be fatal or cause permanent damage to the human health. Thus, use of an autonomous pesticide spraying device would help in avoidance of human exposure to hazardous chemicals and ensures the application of optimal calculated amount of spray to all plants evenly, minimizing waste due to increased accuracy and precision. An autonomous mobile robot was designed for use in pest control and disease prevention applications in commercial greenhouses. The effectiveness of this robotic system is to navigate successfully down the rows of a greenhouse, while the pesticide spraying system efficiently covers the plants evenly with spray in the set dosages (Sammons, 2005)

Data collection: The scientific world demands qualified workers equipped with related expertise and skillful hands for recording observations and other skilled works to be performed in field and lab conditions. An unmanned agricultural robotics system (UARS) was designed, constructed, and operated with multiple sensors, including crop height sensor, crop canopy analyzer, normalized difference vegetative index (NDVI) sensor, multispectral camera, and hyper spectral radiometer by Wang et al., 2014 to measure various morphological data of crop. They reported that UARS, a ground-based automatic crop condition measuring system helped scientific community and also farmers to maximize the economic and environmental benefits through precision agriculture.

Harvesting: Robots in harvesting operation were started with the tomato fruit harvesting robot since 30 years ago. The robot consisted of manipulator, a harvesting end-effector, a color TV camera which was used for stereo vision, and a battery car for traveling in the pre-defined pathway. The robotic technologies were further applied to cherry tomato, strawberry, cucumber, eggplant, cabbage, mushrooms, orange, apple, grape, watermelon, asparagus etc. Although some of the developed robots can automatically perform fruit harvesting operations with a 60-70 % success rate, the robots are still slow and the costs are expensive. The three types of harvesting robot were developed by Hayashi et al. (2005). They reported that prototype strawberry harvesting robot could judge maturity and make basic harvesting movements, eggplant-harvesting robot achieved a harvesting rate of 29.1%, averaging 43.2 seconds per fruit and stereoscopic vision system of tomato-harvesting robot could detect individual fruit and harvest the ripened tomato with an accuracy of 85%.

Post harvest technology: Quality maintenance of horticultural produce after harvest involves many difficult tasks. Consequently, during many post harvest handling operation, all the main movements including package rotation are now carried out by robots, where, few conventional technology and mechanical components are required, resulting in a very reliable system. Crate loaders are also available for pre-pack picking and placing systems that load bags, clamshell and other small package units into the crates or cases at a processing rate of more than one unit per second.

It is also known that quality of agricultural products immediately affects the market value. Therefore, quality maps should also be obtained as well as yield map. Qiao et al., 2005 created a database of spatial yield and quality information for sweet pepper by using the mobile fruit grading robot. Then a real-time mapping method was developed from the database. Three hundred and seventy-two sweet pepper fruits harvested from 300 plants were utilized for the experiment in laboratory. Information such as plant location, harvesting time, fruit index (number of fruits from a plant), fruit size, colour, shape, defects and grade also mass was obtained. Based on these information sources, a database was established to create both a yield map and a quality map. Results indicated that the database was adequate to represent the spatial variability of yield and quality in a field as yield and quality maps, the developed mapping program is effective and practical, and that the system can be applied in real time.

3. Drawbacks In Robotics

Initial cost of robots is very high despite of the many positive application known. Also, robotics in certain situation lacks capability to respond in emergencies, which cause inappropriate and wrong responses, lack of decision-making power, loss of power, damage to the robot and other devices. Furthermore, it is reported that robots even injures human beings.

4. Conclusion

The exploitation of robots in agriculture will rally round in near future and guarantees the increased food production. Robotics and automation can, in many situation, increase productivity, safety, efficiency, quality, consistency of products as well works continuously even in an unfavorable conditions without any humanity needs and illnesses. It is also evident from the research that there is a significant potential for applying these autonomous systems in various agricultural operations when it is possible to impose adequate control and safety regulations systems at reasonable cost. However, certain modification in plant morphological characters like, easy harvest of produce, uniform fruit shape and maturity, training methods etc., will also ensure successful implementation of robotic technology to accelerate plant production.

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Detection Of The Urban Expansion Over Agricultural Land Using Lulc Change Detection Techniques:Case Study El-Mahalla El-Koubra City-Egypt

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A B S T R A C T

The increase in population density is one of the most important factors of urban expansion, which lead to a change in land use. To identify this change three tools are needed, they are Land use / land cover (LULC) change detection techniques, remote sensing data, and a computer system. This paper consists of two parts. The first part presents the concept, implementation, and assessment of seven LULC change detection techniques. These techniques are: post-classification, multi-date direct classification, image differencing, image rationing, image symmetric relative difference, change vector analysis (CVA), and principal component differencing (PCD). These techniques are implemented on remote sensing data of Sharm El-Sheikh city-Egypt, to detect the changes that took place over the period from 2000 to 2010. The post-classification change detection technique provided the highest accuracy of 95.2 %, while the principal component analysis differencing gave the lowest accuracy of 89.6 %. In the second part of the paper the post-classification change detection technique is implemented in the area of El-Mahalla El-cobra City-Egypt to detect the urban expansion over the agricultural area through the period from 2010 to 2015. The results showed that, the agricultural area was decreased by 6.04 % and the urban area was increased by 31.2 %.

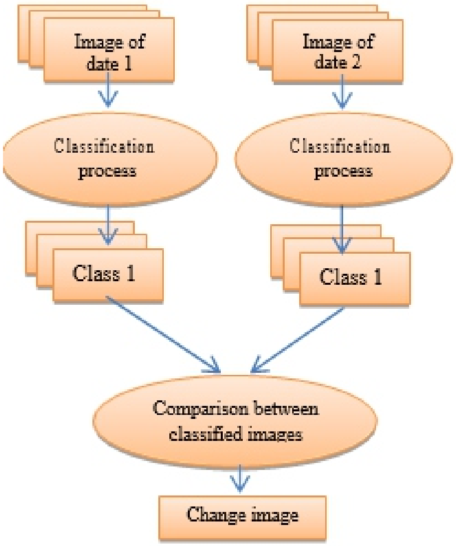
Keywords Land use / Land cover (LULC), post classification, multi-date direct classification, image differencing, image rationing, image symmetric relative difference, Change Vector Analysis (CVA) and principal component differencing (PCD).

1. Introduction

The earth's surface is changing due to human activity or natural phenomena, for example, urban growth, wildfires, agricultural expansion, storms, and military conflicts[1,2]. The earth's surface changes can be classified into two main categories: land use and land cover (LULC)[3]. Land cover is used to illustrate the physical state of the land surface such as cropland, forests, wetlands, human structures such as pavements, buildings and other aspects of the natural environment, including surface water , biodiversity, groundwater and soil type[4]. Land use illustrates the human way in using the land and its resources, including mining, agriculture, grazing, urban development and logging[5]. SO, Land use is considered to be a product of interactions between a society's cultural background, state and its physical needs on the one hand and the natural potential of land on the other hand[6]. LULC change detection techniques are considered to be the scientific and rapid way to detect the changes on the earth's surface, especially in the presence of the past and present land use/cover data of the study area[7]. environmental changes[6]. Generally, LULC are interdependent and closely related so they are often used interchangeably[8].

2. Categories Of Change Detection Methods

Change detection is the process of identifying differences in the state of an object or phenomenon by observing it at different times[9]. This observation can be done through remote sensing data of the study area acquired at different dates, where the changes in radiance values of the data appear as a result of land Class 2cover changes. Since launching of the first Landsat satellite in 1972, till now, a wide range of remote sensing data with different spectral, spatial, radiometric and temporal resolutions are available[10].This is necessary for the LULC change detection process[7]. It allows to perform LULC change detection on different temporal scales[11], and leads to the development and evaluation of many digital change detection methods for analyzing and detecting LULC changes[12]. It is extremely difficult to state the most proper method of detecting changes, generally it is application dependent. Generally change detection methods can be classified into two main categories: pre-classification and post-classification change detection methods [3]. Post-classification approach for change detection has been proven to be the most popular approach in change detection analysis[13]. This approach is based on rectification of more than one classified image, then comparison between them as shown in Fig (1). It minimizes sensor, atmospheric, and environmental differences because data from two dates are separately classified, thereby minimizing the problem of normalizing for atmospheric and sensor differences between two dates and it provides a complete matrix of land cover change when using multiple images[14].The pre-classification comparison approach for change detection is identified as the most accurate change detection approach because, they are straight forward, effective for identifying and locating change and are easy to implement[15]. However, three aspects are critical for pre-classification techniques: selecting suitable thresholds to identify the changed areas, being sensitive to misregistration of pixels, and they cannot provide details of the nature of change or provide a matrix of information change[16]. Fig (2) illustrates the procedures of post-classification technique.



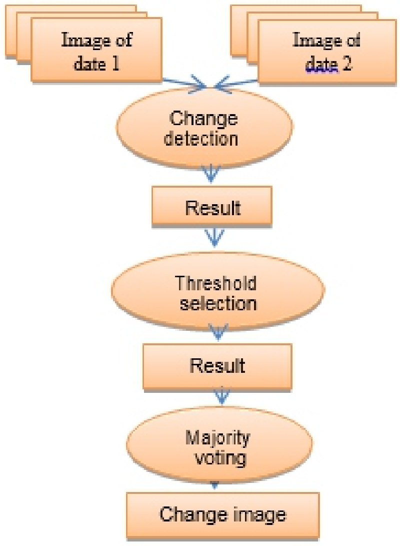


Fig (1): Main procedures of post-classification change detection approach

Fig (2): Main procedures of pre-classification change detection approach

3. The concepts of the selected change detection methods

Seven LULC change detection techniques are selected to be implemented on our dataset. These techniques are post-classification, direct multi-date classification (DMDC), image differencing (ID), image rationing (IR), image symmetric relative difference (ISRD), change vector analysis (CVA), and principal component differencing (PCD).

ID is based on the subtraction of two spatially registered imageries, pixel by pixel, as follows:

$$ID = Xi\,(t2) - Xi\,(t1) \qquad (1)$$

Where X represents the multispectral images with I (number of bands) acquired at two different times t1and t2.

The pixels of changed area are expected to be distributed in the two tails of the histogram of the resultant image, and the unchanged area is grouped around zero. This simple method easily interprets the resultant image; however, it is crucial to properly define the thresholds to detect the change from non-change areas[3].

IR is similar to image differencing (ID) method. The only difference between them is the replacement of the differencing images by rationed images[3].

IR = Xi (t2) / Xi (t1)   (2)

ISRD is based on the use of symmetric relative difference formula to measure change[17], as follows:

$$\text{ISRD} = \frac{X_i(t_2) - X_i(t_1)}{X_i(t_2)} + \frac{X_i(t_2) - X_i(t_1)}{X_i(t_1)} \quad (3)$$

Dividing the difference by the pixel's value at time 1 and time 2 allows the derivation of a change image that measures the percentage change in the pixel, regardless of which image is chosen to be the initial image. For example a pixel that had a value of 20 at time 1 and a value of 80 at time 2 would have an absolute difference of 60, and a percentage change value in the change image of 375%:

[(80 – 20) / 20 + (80-20)/80] * 100 = 375%

Another pixel with a value of 140 at time 1 and 200 at time 2 would also have an absolute difference of 60, but its percentage change would only be 72.86%:

[(200 – 140) / 140 + (200-140)/200] * 100 = 72.86%

In most cases it can be assumed that the percentage change of a pixel's brightness value is more indicative of actual change in the image than simply the absolute difference[18].

CVA generates two outputs: a change vector image and a magnitude image. The spectral change vector explains the direction and magnitude of change from the first to the second date. The total change extent per pixel is calculated by determining the Euclidean distance between end points through dimensional change space, as follows:

$$\left|\text{CVA}\left(\text{X}(t_2), \text{X}(t_1)\right)\right| = \sqrt{\Sigma_i \left(X_i(t_2) - X_i(t_1) \right)^2} \quad (4)$$

A decision on change is made based on whether the change magnitude exceeds a specific threshold. The geometric concept of CVA is applicable to any number of spectral bands[19].

PCD is often as accepted as an effective transforms to derive information and compress dimensions. Most of the information is focused on the first two components. Particularly, the first component has the most information. The difference of the first principle component of two dates has the potential to improve the change detection results, i.e.

$$PCD= PC1 (X(t2)) - PC1 (X(t1)) \quad (5)$$

The change detection is implemented based on threshold[3].

DMDC it combines the two images (X(t2) and X(t1)) into a single image on which a classification is performed. The areas of changes are expected to present different statistics (i. e., distinct classes) compared to the areas with no changes[20].

Post Classification is based on the classification of the two images (X(t2) and X(t1)) separately and then compared. Ideally, similar thematic classes are produced for each classification. Changes between the two dates can be visualized using a change matrix indicating, for both dates, the number of pixels in each class. This matrix allows us to interpret what changes occurred for a specific class. The main advantage of this method is the minimal impacts of radiometric and geometric differences between multi-date images. However, the accuracy of the final result is the product of accuracies of the two independent classifications (e.g., 64% final accuracy for two 80% independent classification accuracies)[20].

4. Experimental work (part 1)

4.1. Dataset of the study area

Fig (3) shows the dataset of Sharm el-Sheikh city- Egypt. It consists of two images acquired by Landsat 7 at 2000 and 2010 respectively. Each one represents an area that lies between Lat. 28 0 37.0091 N, Lon. 34 17 56.3381 E and Lat. 27 57 20.8804 N, Lon. 34 24 43.6080 E. Table (1) summarizes the characteristic of this dataset.

el-Sheikh city- Egypt Fig (3): Dataset of Sharm (Landsat 7)

Table (1): Characteristic of Sham el-Sheikh dataset

No	Spatial resolution	Radiometric resolution	Number of bands	Acquisition date	Size [pixels]		Area [km^2]
					Width	Height	
1	30 m	8 bits	3	2000	382	364	12.5143
2	30 m	8 bits	3	2010	382	364	12.5143

4.2 Computer system

A laptop machine with processor Intel(R)core(TM)i7-4500U CPU @1.80 GH 2.40 GH and RAM 8 GB is used.The model maker in the ERDAS IMAGINE 2014 software is used.

4.3 Experimental procedures

4.3.1 Pre-processing

Before implementation of the change detection techniques, it is essential that the changes in the objects of interest should indicate changes in radiance values not the changes produced from other factors such as variation of solar illumination conditions, atmospheric conditions, differences in soil moisture, viewing geometry at different acquisition times and acquiring from different sensor [14],[21],[22].The impact of these factors may be reduced by selecting the appropriate data [9] and applying preprocessing treatment (image registration, if needed, and radiometric correction) [23]. In this paper the selected dataset had already registered. Radiometric correction is carried out to minimize the false change detection [24], so the pixel of the unchanged areas in one date, should take the same or close gray level values of the corresponding pixels in the other date. Histogram matching technique between the two images was applied for radiometric correction after normalization of both images[25].

4.3.2 Implementation and accuracy assessment of the change detection methods

The steps of implementation of each method are given in table (2). The change error matrix or the confusion matrix, table (5) is used to calculate the overall accuracy[26],[27]. It contains the reference information which was taken visually by comparing the dataset. The overall accuracy, user accuracy and the procedures, accuracy can be calculated from the change error matrix.

$$\text{The overall accuracy} = \frac{\text{total number of the correct classified change}}{\text{total number of classification}} \quad (6)$$

$$\text{The user accuracy} = \frac{\text{number in diagonal cells of the error matrix}}{\text{total number in row}} \quad (7)$$

$$\text{The procedure accuracy} = \frac{\text{number in diagonal cells of the error matrix}}{\text{total number in columns}} \quad (8)$$

The seven techniques were implemented by the model maker in the ERDAS IMAGINE 2014 software for dataset of Sharm el-Sheikh to provide an overview and assessment for LULC change detection techniques by using 250 random points to generate the change error matrix to evaluate the overall accuracy. Table (3) illustrates the overall accuracy and the rate of change in the area for each technique. Fig (4) shows the change image of the seven techniques.

Table (2): Steps of the seven change detection techniques implementation

Method	Procedures
Image differencing **ID**	1- Applying Eqn (1)
	2- Threshold values were determined according to the statistical calculation by taking (1* STD) to identify the land cover change. This step provides a binary image for each band, 1 as change and 0 as non-change.
	3- The change image is produced according to the majority voting between the binary images.
	4- The overall accuracy is calculated by Producing change error matrix using 250 random variables.
Image rationing **IR**	1- Apply Eqn (2)
	2- Thresholds were determined as mentioned before
	3- Change image is produced through majority voting between the binary images 4- The overall accuracy is calculated by Producing change error matrix using 250 random variables
Image symmetric Relative Difference **ISRD**	1-Apply Eqn (3)
	2- Thresholds were determined as mentioned before
	3- Change image is produced through majority voting between the binary images 4- The overall accuracy is calculated by Producing change error matrix using 250 random variables
Change Vector analysis **CVA**	1- Apply Eqn (4) to get the Euclidian distance between the two dates 2- Thresholds were determined as mentioned before
	3- Change image is produced through majority voting between the binary images 4- The overall accuracy is calculated by Producing change error matrix using 250 random variables
Principal component differencing **PCD**	1- Get the principle component of the two images 2- Apply Eqn (5)
	3- Thresholds were determined as mentioned before
	4- Change image is produced through majority voting between the binary images 5- The overall accuracy is calculated by Producing change error matrix using 250 random variables
Direct multi-date classification **DMDC**	1- First, stack all layers in date 1 and date 2 together
	2- Provide unsupervised classification using K-means classifier for the output image to get 20 classes
	3- Reduce the 20 classes to 2 classes using recode process to get the change image 4- The overall accuracy is calculated by Producing change error matrix using 250 random variables
Post classification	1- Provide unsupervised classification using K-means classifier for each image to get 20 classes
	2- Reduce the 20 classes to 4 classes using recode process
	3- Compare the class pixel between the two images to produce the change image. 4- The overall accuracy is calculated by Producing change error matrix using 250 random variables

Table (3): Overall accuracy and the rate of change in area for each technique

Method	ID	IR	ISRD	CVA	PCD	DMDC	Post Classification
Overall Accuracy	92.40%	91.60%	91.60%	92.40%	89.60%	94.40%	95.20%
Rate of area Change	12.05%	11.13%	8.01%	7.67%	19.43%	8.01%	11.21%

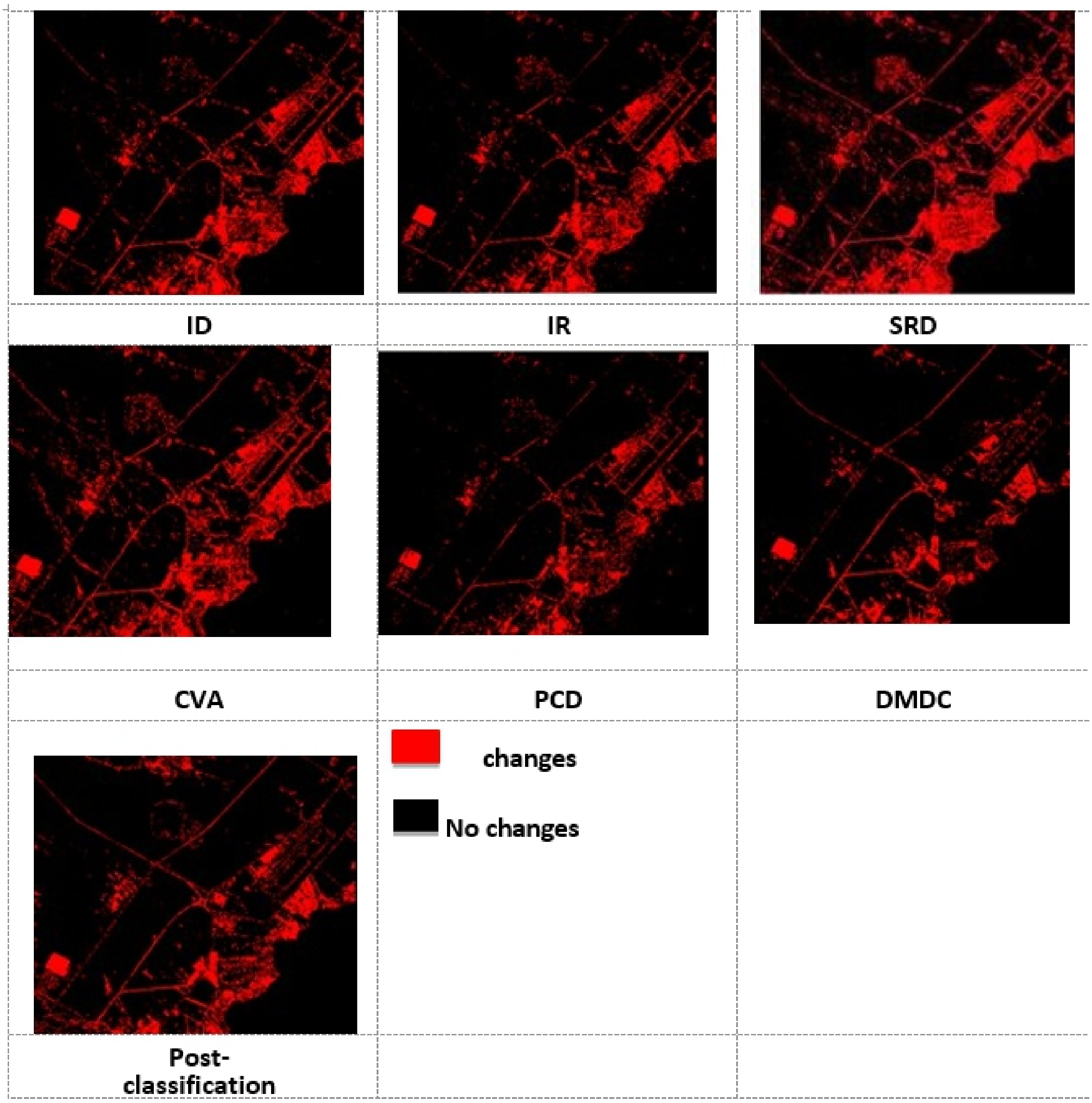


Fig (4): Change images after applying the seven techniques on Sharm el-Sheikh city- Egypt dataset

5. Experimental work (Part 2)

5.1 Dataset of the study area

Fig (5) shows the dataset of a village next neighbour of Mahalla al-Kubra city in Egypt. It consists of two images taken by El-Shayal Smart web on Line Software that could acquire Satellite images from Google Earth. The dataset was acquired at scale 1.600 Km. It lies between Lat. 30 57 46.9032 N, Lon. 31 14 35.4776 E and Lat. 30 54 47.00 N, Lon. 31 18 19.98. Table (4) summarizes the characteristic of this dataset.

Fig (5): dataset of Mahalla al-kubra city- Egypt (Google Earth)

Table (4): characteristic of Mahalla al-Kubra cities Egypt dataset

No	Spatial resolution	Radiometric resolution	Number of bands	Acquisition date	Size [pixels]		Area [km^2]
					Width	Height	
1	6 m	8 bits	3	2010	1056	1007	38.2821
2	6 m	8 bits	3	2015	1056	1007	38.2821

Note: the same computer system is used with the second experimental work. Also the same pre-processing is applied to the dataset of the experimental work (part 2).

5.2 Implementation and accuracy assessment of post classification change detection method

The post classification technique was applied to the dataset, fig (5) to detect the urban expansion on agricultural land. 100 random points were selected to generate the change error matrix as shown in table (5). The overall accuracy of the change image 95 % and the procedure accuracy were 100 % and the user accuracy was 54.55%. The change image is given in Fig (6).

Table (5): the change error matrix of the change image that produced from the post classification techniques

Classified data	Reference data		
	No Change	Change	Total
No Change	89	0	89
Change	5	6	11
Total	94	6	100

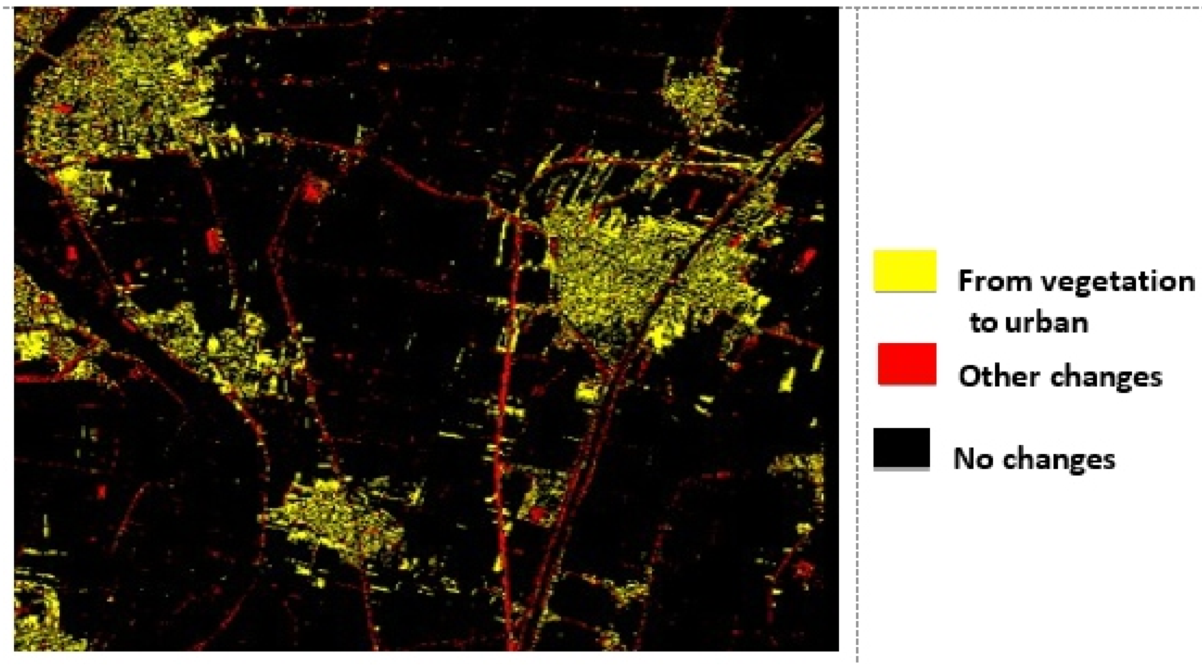


Fig (6): change image after applying the post classification technique for giving dataset of Mahalla al-Kubra city- Egypt

6. Analysis

Fig (7) gives a chart of the overall accuracy of the seven LULC change detection techniques that applied on the Sharm el-Sheik city. The post classification technique provides the highest overall accuracy compared to the other six techniques as it reduces the false change by minimizing sensor, atmospheric, and environmental differences. It has the ability of providing a complete matrix of land cover change, but there is one shortcoming of this method is the high requirements for a reasonable classification of categories as, the accuracy of the final result is the product of accuracies of the two independent classifications. Direct multi-date classification is quick and easy. It has the same advantages of the post-classification technique. In addition, the error rate will not be cumulative like post classification, but the results are difficult to interpret without a good knowledge of the study area. The change vector analysis has ability to process any number of spectral bands and also provides detailed information about change measure. Although the ISRD has lower accuracy than ID but its output has an indication of the actual change that happen in the study area. The principal component differencing technique is an effective transforms to derive information and compress dimensions. But, it provided the least overall accuracy as most of the information is focused on the first two components.

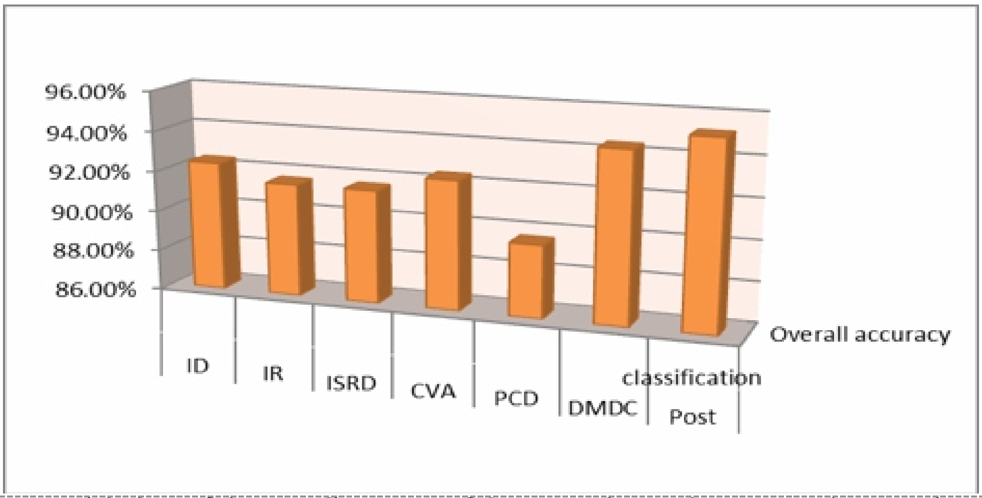


Fig (7):Chart of the overall accuracy of the seven change detection techniques that applied on the Sham el-Sheik city

Applying post classification techniques in the dataset of fig (5) indicated that 10.33 % has been changed from the total study area, the agricultural land was decreased by 6.04 % from the total agricultural area. The urban area was increased by 31.2 % from the urban area through the period from 2010 to 2015, as shown in Fig (8) and table (6).

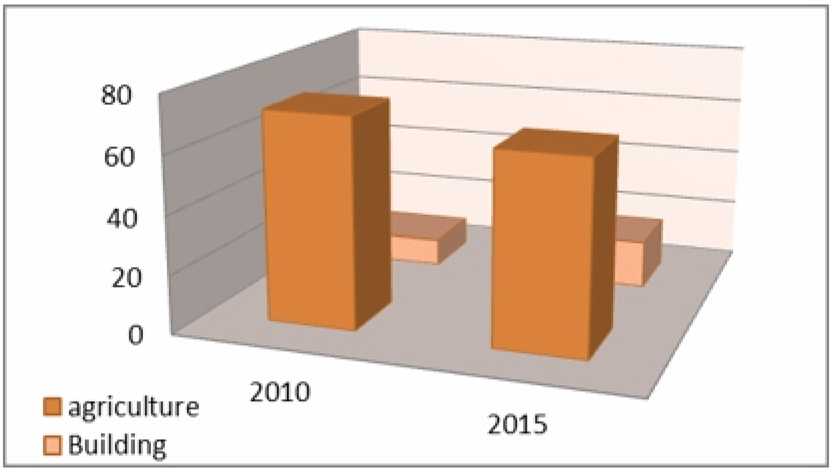


Fig (8):The changes that took place in the agriculture land through the period from 2010 to 2015 in El-Mahalla el-koubra city - Egypt

Table (6): The rate of change in area for agriculture and building that took place in El-Mahalla el-koubra city - Egypt

Type	2010	Percentage of total area	2015	Percentage of total area	Rate of change
Agriculture	27.6702 Km^2	72.27%	25.9967 Km^2	65.28%	Decreased by 6.04 %
Building	3.62344 Km^2	9.46%	5.27261 Km^2	16.46%	Increased by 31.2 %

7. Conclusion

Land Use and Land Cover change detection are one of the most important applications of remote sensing. Detecting and analyzing these changes can be done through a process commonly called 'change detection' by using remote sensing satellite data. There are many digital change detection techniques have been developed to detect and analyze Land Use and Land cover changes. They can be divided generally into two categories: pre-classification and post- classification change detection techniques. There are six main steps to detect the changes, determine the nature of the change detection problem, selection of remotely sensed data, image preprocessing, image processing or classification, selection of change detection techniques and finally evaluate the change detection results. However, the post-classification change detection technique in this study has provided the highest overall accuracy compared to the other six change detection techniques. But it is very difficult to assess the most proper technique for detecting Land Use and Land Cover changes in a particular area under study as the nature of the physical characteristics of the features of interest, the analyst skills and the characteristic of the available dataset vary.

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Indian Jute Industry-Environmental Issue

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A B S T R A C T

Weaving, Broadloom, Spinning and Stitching department of the Jute Industry are exhibited higher than 90 dB(A) Noise level . These department also accident prone areas. So, higher Noise level gives irritation, less attention at work place, which causes higher work place accidents, injuries. Significant difference of illumination at night time 'Lux' data, which are much less than standard norms. Day time value of illumination of various department are maintaining standard. Higher illumination at work place of various department are required to improve for better productivity and control of injury at work place.

Key Words :Workplace, Injury, illumination, Noise, weaving, Spinning

1. Introduction

Jute, a major agro produce of the country has over the years helped to develop a giant agro industry which is one of the oldest sectors in India's agricultural and industrial economy with a significant base in Eastern and North Eastern states of the country. The Indian Jute Industry presently is no longer dependent on Sacks only but has proliferated in making of diverse utility, home décor. Lifestyle and engineering products. Indian Jute Sector is now number one Jute goods production and second in exports of Jute in the world.. Major exportable items of Jute goods are Hessian, Yarn, CBC in the traditional Sector while floor coverings and Hand & Shopping Bags are in the areas of diversified Jute Products. Recently food grade Jute Cloths and Bags (FGJP) and Jute Geo-Textiles (Soil Savers) have emerged as the other potential exportable Jute items. Food grade Jute Products have been made compulsory by the International cocoa organization (ICCO) for exporting cocoa beans and also recommended by international coffee organization for exporting coffee beans. Jute geo-textiles have tremendous applications in solving different geo-technical problems. Under this circumstance, Environmental , Safety issues of jute industry are highly essential for Effective Human Resource Management at work place. Present manuscript helps to identify workplace environmental and safety status of Indian Jute Industry and corrective measures required to safe workplace environment.

Research Methodology :-A few measurement has been performed at various department of Jute Industry in Howrah district of West Bengal, India. The name of the unit is Bally Jute Company Limited.

Different. Environment performance issues at workplace are measured and analyzed in this manuscripts. The Data Collected are primary in nature. Four months study was taken related to industry major injury at various department. After Collecting the data, analysis has been done to attain a suitable corrective measures plan.

Study Area :- Bally Jute Company Limited is a pioneer jute industry in West Bengal as well as India. The unit is under Kankaria group. The unit is situated at Bally of Howrah District of West Bengal. It is very close to the 'Bally Station'. More than 3000 employees are working here per day. The unit is ISO - 9001 : 2008, ISO - 14001 and OHSAS 18001 : 2007 certified unit. The unit produces A.Twill, B.Twill, Different Jute Bags, Jute Cloth, Yarn, Jute Twine, Carpet Backing Cloth, Bags for Hydrocarbon free Bags.

Literature Review :

Jan zera.[1] (2001) disclosed in his research findings thatImpulse noise generated by industrial machines and occurring at a workplace is a cause of substantial hearing loss in workers. The paper presents data on workplace impulse noise, recorded in three plants of the machine industry. The data were collected in drop-forge, punch-press and machinery shops. The results of the measurements are shown as cumulative relative frequency distributions of the C-weighted peak sound pressure level, LCpeak, the A- weighted maximum RMS sound pressure level (SPL), LAmax, and the A-weighted sound exposure level, LEA of isolated acoustic impulse noises. The survey shows that in the drop-forge shop over 90% of acoustic impulses generated by hammer strikes exceed permissible levels of LCpeak = 135 dB and Lamax = 115 dB. In the stamp-press shop, only 10–20% of impulses generated during the technological process exceed maximum permissible levels.

Mallick M M[2] et al ,(December 1988) concluded in research findings that the problem of nose in jute industry is one that has become increasingly more important as it has a direct bearing on comfort. The emission of nose during jute processing is a notorious characteristics of the industry. In this paper, two aspects of the subject are relevant: (I) to measure the noise level in different sections of the jute industry and (II) to find out the possible way to reduce the problem of noise pollution. Noise level of different sections of jute industry was measured. The maximum and minimum noise level recorded were 107 dBA and 82 dBA. However, 85 dBA is the accepted tolerable sound level for jute and Textile industries. It was found from the recorded data that the noise level is maximum (107 dBA) in weaving section and minimum (82 dBA) in Softener section. Efforts were made to reduce such high level sound by using sound absorbing materials. Jute felts from Jute caddies were found more suitable and cheapest sound absorbing materials. It reduces sound level ranging 6 to 9 dBA. Workers engaged in weaving, spinning, drawing and winding section where the sound level is considerably high should use sound ear protector to avoid such level noise. Another way of reduction of sound level in alternation of metallic gearing system by special type of hard nylon gear.

W Taylor [3] ((1967),et al , concluded in their research paper that the noise levels in Dundee weaving sheds, as in other mills in which traditional looms are in operation, constitute an appreciable hazard to hearing when weavers are exposed over a period of from ten to fifteen years to noise levels in the range 99–101 dB. This paper describes an attempt to reduce loom noise by the substitution of plastics materials for metallic bearing and impact surfaces.The noise reduction achieved in a test loom by substituting plastics components was found to be of the order of only 2–3 dB, limited to the range 0·5– 2·0 kc/s. Although small reductions of this order are desirable and worth while, loom-noise levels at present are far above the Damage Risk Criteria for human hearing, and efforts on the part of loom manufacturers to reduce over-all noise levels will require to be made, especially in new machinery.

Kell R L [4] (1971) concluded in his research paper that Audiometric results are presented for a study of hearing impairment in female jute weavers and controls. They are shown to agree well with an earlier independent measurement of jute weavers by TAYLOR et al. (1965) and the predictions of PASSCHIER- VERMEER (1971), but to exceed the predicted hearing levels of BURNS and ROBINSON (1970) which forms the basis for the Hygiene Standard for Wide-band Noiseof the BRITISH OCCUPATIONAL HYGIENE SOCIETY (1971).

Chandrasekar K [5] (January 2011) concluded in his research paper that the workplace environment impacts employee morale, productivity and engagement - both positively and negatively. The work place environment in a majority of industry is unsafe and unhealthy. These includes poorly designed workstations, unsuitable furniture, lack of ventilation, inappropriate lighting, excessive noise, insufficient safety measures in fire emergencies and lack of personal protective equipment. People working in such environment are prone to occupational disease and it impacts on employee's performance. Thus productivity is decreased due to the workplace environment. It is the quality of the employee's workplace environment that most impacts on their level of motivation and subsequent performance. How well they engage with the organization, especially with their immediate environment, influences to a great extent their error rate, level of innovation and collaboration with other employees, absenteeism and ultimately, how long they stay in the job. Creating a work environment in which employees are productive is essential to increased profits for your organization, corporation or small business. The relationship between work, the workplace and the tools of work, workplace becomes an integral part of work itself. The management that dictate how, exactly, to maximize employee productivity center around two major areas of focus: personal motivation and the infrastructure of the work environment.

Results And Discussions

Table - 01 : Noise Level Monitoring at various Department of the Mill

Location	Time	Reading in db (Range)	Temperature	Time	Reading in db (Range)	Temperature
Selection	Day Time	74.4 - 75.6	32°C	Night Time	69.8 - 72.6	30°C
Spreader	"	90.3 - 92.3	31°C	"	88.0 - 89.1	30°C
Carding	"	90.8 - 91.2	31°C	"	90.8 - 91.7	30°C
Drawing	"	90.2 - 91.1	31°C	"	90.3 - 91.0	30.5°C
Spinning	"	92.1 - 92.7	32°C	"	92.9 - 93.5	32°C
Winding	"	89.0 - 90.4	32.5°C	"	85.5 - 91.3	32.5°C
Cop Winding	"	87.0 - 88.3	32°C	"	86.9 - 88.0	32°C
Beaming	"	83.2 - 88.0	32.5°C	"	88.2 - 89.0	32.5°C
Broad Loom	"	92.1 - 94.2	32.5°C	"	93.2 - 95.8	32.5°C
Weaving	"	99.2 - 100.3	33.5°C	"	87.4 - 89.0	32.5°C
Stitching	"	92.5 - 94.0	32°C	"	90.0 - 92.9	30°C
Packing	"	77.9 - 78.8	32°C	"	-	30.5°C
Finishing	"	92.9 - 93.4	32°C	"	94.6 - 95.5	31°C
Bale Godown	"	70.4 - 74.5	31.5°C	"	77.9 - 83.7	30°C

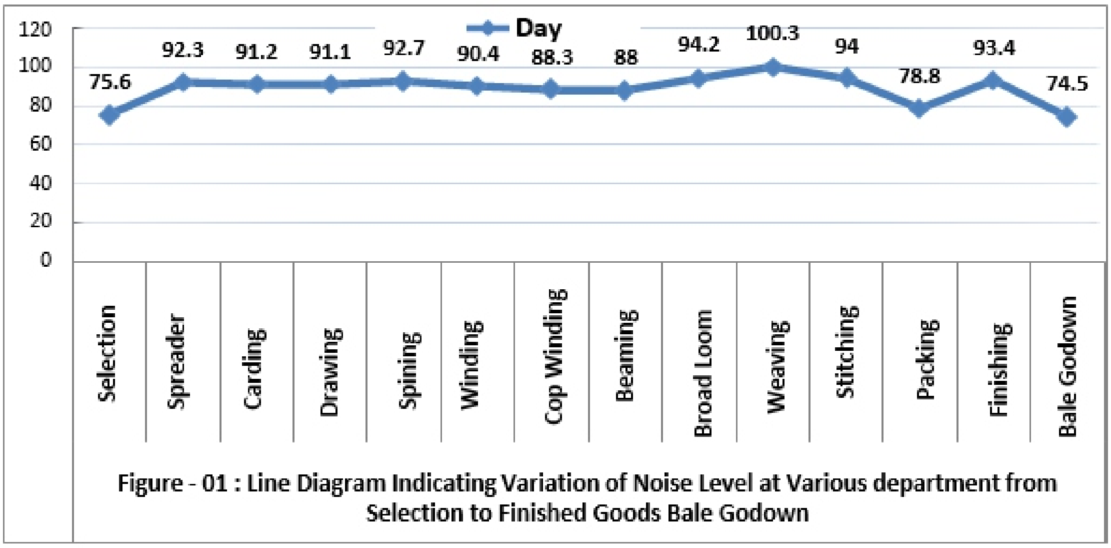
Source :- Data obtained during measurement at various department of BJCL

Table 01 explained that dB(A) value of Noise at Night time is slightly less than day time. Carding , Spinning , Winding, Beaming , Broadloom, Finishing , Bale Godown exhibited higher dB(A)range at night time than day time. These are due to some machines on such department under maintenance operation at day time. Packing at night time remained stop. As a result there are no data recorded .Figure 01 explained the variation of Noise level dB(A) of various department, starting from selection (Production Starting area) to Finished goods godown at day time .Figure 01 exhibited that higher Noise level (DB) is observed in Weaving department, where 100.3 dB

(A) Noise level are recorded. This is due to various orthodox shuttle looms are operating in such department. Lot of motions are operating in each cycle of rotation picking of this shuttle loom, which creates high Noise level. Next to Weaving , Broadloom, Stitching and Spinning are occupied in 2nd , 3rd and 4th position in Noise generating departing of Jute industry .In Broadloom, Big shuttle picking , housing, shedding , Beat Up motions are generating high Noise generating point of such department .In

Spinning , a large number of two leg flyer are rotating at 4200 rpm which creates high noise generation. Motions and Power transmission through various gearing creates high Noise level to spinning section .

Figure - 01: Line Diagram Indicating Variation of Noise Level at Various department from Selection to Finished Goods Bale Godown



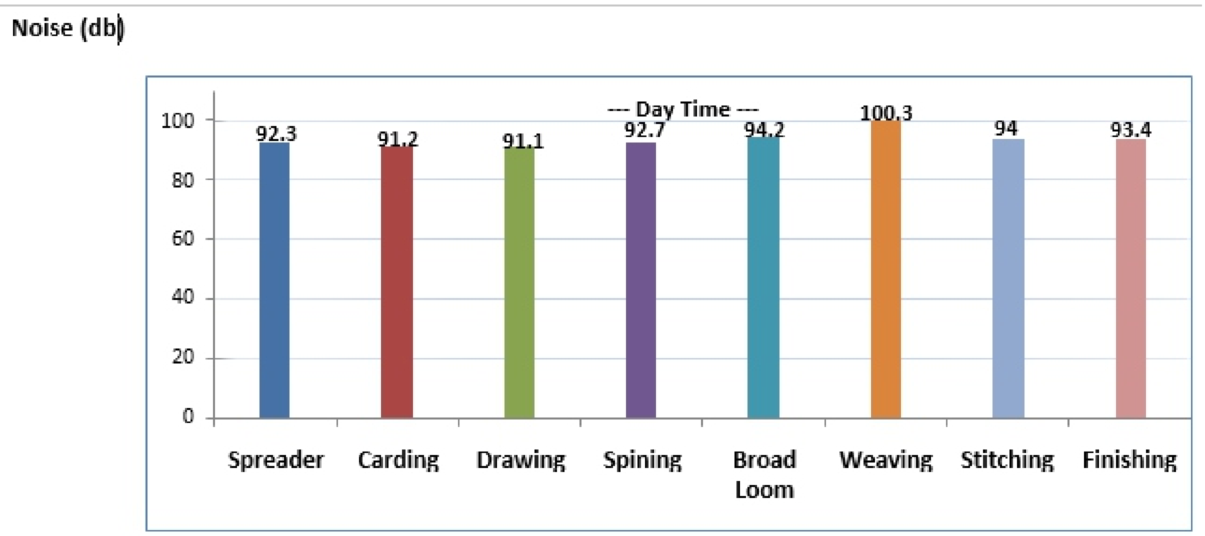


Figure 02 : Bar Diagram Indicating Department having Noise (db) higher than 90 db

Table 02: Department wise distribution of Injured Incidents

Departments	No. of Persons Injured	%age based on Total
Hessian Weaving	33	21.85
Sacking Weaving	18	11.92
Spinning	17	11.26
Warp Winding	16	10.6
Preparing	13	8.61
Batching	12	7.95
Weft Winding	11	7.28
Sack Sewing	10	6.62
Broad Loom /CBP	9	5.96
Beaming	6	3.97
Finishing	2	1.32
Factory Mechanic	2	1.32
Mill mechanic	2	1.32
Total :	151	100

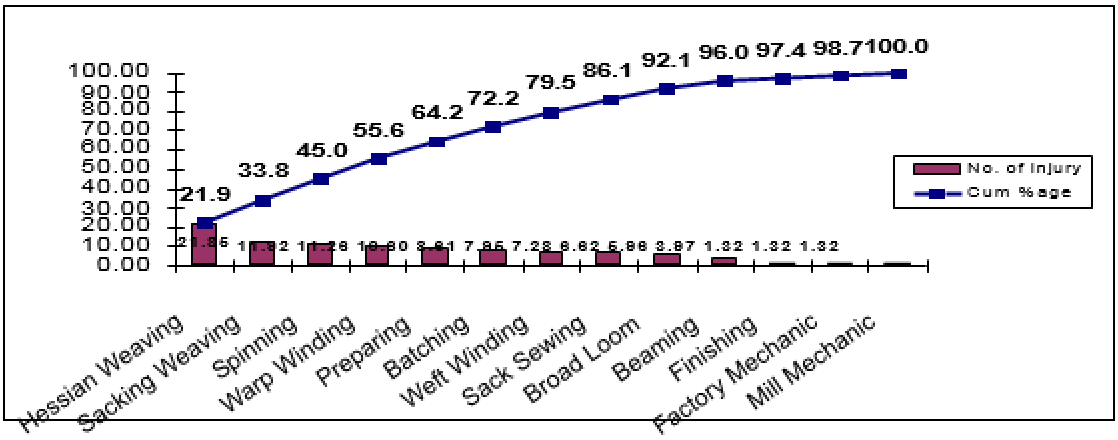


Figure03: Paratoo chart indicating Department wise injury incidents

Figure 02, explained the department of Jute industry, which exhibited higher dB (A) value and greater than 90dB(A). It is known that 8 hrs exposure in 90 dB(A) , is the industry Norms for Noise. Working place higher than 90 dB(A) creates health hazards, accidents at the work place.

A study has been conducted at Jute Industry of BJCL for 4 months. 151 major injuries has been registered in 4 months study periods. It is found that, Hessian Weaving , Sacking Weaving are exhibiting 33 and 18 number of major injuries in such department ,whereas spinning department is exhibited 17 number of major incidents of injury within study period. Figure 03 is exhibited Paratoo chart distribution of various department of Jute Industry. From the foregoing discussion , it is found that higher noise level (DB) creates higher level of injuries, accidents at work place again proved from this study. Weaving department is exhibited higher noise level , higher than 100 dB (A) which creates higher number of injury incidents during 4 months study periods at the study place.

Table 03 is exhibiting various illumination value (lux) on various department. Obviously, Night time temperature is much less than Day time. As per norms of BIS ,Weaving , Spinning Winding should have 150 Lux . The Observed value at such department are much less than standard at night time, This should be improved at Night time for efficient running of such department.

Management Initiatives

- Use of Mask of the employees working at Weaving , Broadloom ,Spinning and Winding , Batching Department.
- Use of Ear Plug of the Workers at Weaving and Broadloom section.
- Installation of Rapier looms (Shuttle less looms) and withdrawal of conventional shuttle looms which enhances productivity and lower health hazards.
- 24*7 hours Emergency Ambulance Service .
- Well Equipped Dispensary and 24 hours skilled trained medical staff.
- Free consultation of Medical Doctor at dispensary
- Regular cleaning of machines and work Place
- Sufficient Led tube light at various department.
- Training of labors by external Experts for improvement of Skill, Competency of different jobs at work place.
- Maintain proper schedule of preventive Maintenance.
- Care about proper Lubrication at Different Machineries
- ESI facilities to the Workers and their family
- Enhancement of Space between Weaving machines at Weaving Section by reinstallation at New Shed of Weaving.

Table-03: Illumination Measurement at Various Department of the Mill

Location	Time	Reading (Lux)	Temperature	Time	Reading (Lux)	Temperature
Selection	Day Time	537 - 542	32°C	Night Time	008 - 013	30°C
Spreader	"	151 - 155	31°C	"	018 - 030	30°C
Carding	"	050 - 055	31°C	"	024 - 032	30°C
Drawing	"	078 - 081	31°C	"	022 - 026	30.5°C
Spinning	"	106 - 110	32°C	"	031 - 084	32°C
Winding	"	113 - 115	32.5°C	"	019 - 037	32.5°C
Cop Winding	"	038 - 040	32°C	"	024 - 036	32°C
Beaming	"	079 - 081	32.5°C	"	047 - 082	32.5°C
Broad Loom	"	174 - 181	32.5°C	"	027 - 048	32.5°C
Weaving	"	138 - 151	33.5°C	"	049 - 058	32°C
Stitching	"	090 - 196	32°C	"	027 - 033	30°C
Packing	"	151 - 164	32°C	"	020 - 049	30.5°C
Finishing	"	107 - 260	32°C	"	008 – 017	31°C
Bale Godown	"	013 - 040	31.5°C	"	002 - 022	30°C

Source :- Data obtained during measurement at various department

Conclusion :

Jute Industry contributes economic development of Indian Nation. A large number of peoples are engaged from Raw Jute cultivation to Jute goods manufacturing sector in India. Jute industry is labor intensive industry. A large number of workmen are involved in day-to-day at work place. So, control of safety , health hazards at work place are essential factors in Jute Industry. Top management of Jute Industry should maintain proper safety precautions at work place and reduction of health hazards so that workmen can efficiently participate in enhancement of productivity and product quality .as per the customers requirement.,

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