Rural Development of Pakistan with IoT

ABSTRACT

The study acknowledged the Internet of Things (IoT) as it relates to increasement of agriculture and rural productivity. It's importance in the area of the irrigation/fertilizer application, weather forecast, internet banking, tracking of farm produce, pests, and disease handling and control were seen. However, Pakistani agriculture has not indicated such realignment and transformation due to some challenges. Rural cities of Pakistan face several identical issues in the domains of agriculture, connectedness, health, transport, water, and education, and many more that can play a necessary part in the development of rural areas, which claims for potentially comparable solutions to be applied towards solving these issues. The purpose of this research is to check out the potential contributions of the IoT technologies towards poverty minimization in these rural areas, in order with the requirements are seen in these societies and with the concern on agriculture. The paper classifies the usage of IoT technology can easily reduce the agricultural needs of these communities or also improve their lifestyle for the domains of crop farming, weather forecasting, rural financing, livestock farming, growth management, market identification, and forest ranging. Accordingly, some recommendations were carried out to oppose these barriers and move Pakistan agriculture to an excellent status of world-class standards.

Keywords: *IoT, Rural development, Agricultural development in Pakistan, Poverty reduce with IoT*

1. INTRODUCTION

Agricultural informatics, again handed over to as agriculture, is a field that links the progress in agricultural intelligence, rural evolution and entrepreneurship to serve agricultural-services, enhanced-automation, propagation, and information distribution through intelligence and communications technologies (ICT) and the Internet [1]. E-agriculture concentrates on boosting agricultural and agrarian development through enhanced information and communication handling. More specifically, e-agriculture covers the conceptualization, architecture, advancement, assessment and operation of ingenious steps to adopt ICT in the agricultural territory with a concentrate on agriculture [2]. ICT is an umbrella term that holds everything from radio to satellite technology to mobile phones or electronic cash supplies. There is an increasing influence in the potentiality of IoT technologies to reinforce poverty alleviation and the upliftment of the remaining ideals of populations in agricultural sectors. The improvement of this exploration is the examination of the probable improvements of IoT to the territory of agriculture for rural surroundings of Pakistan. IoT on the separate palm is the hooking up of substantial things on the internet that creates its potential to access remote sensor data and manipulate the substantial system from a distance [3]. The IoT has the purpose of serving an ICT-infrastructure facilitating the swap of 'things' in a protected and steady procedure, i.e. its function is to overwhelm the rift between items in the physical world and their portrayal in information systems [4].

The rest of the paper is formatted as supports:
Segment 2 is on ICT trainer in agriculture. Segment 3 is on ICT hurdles for rural areas. Segment 4 is on the problem. Segment 5 is on agriculture of Pakistan. Segment 6 is on IoT in agriculture. Segment 7 is on related literature. Segment 8 is on advantages of IoT to agriculture. Segment 9 is the outcome.

2. ICT TRAINER IN AGRICULTURE

The advance in ICT affordability, convenience and flexibility has arisen in their adoption even within rural farms relying on agriculture. The trainers of ICT in agriculture are:
1) Moderate-cost and ubiquitous connectivity.
2) Malleable and better economical tools.
3) Raises in data repository and swap.
4) New business designs and shares.

5) Claim for agricultural information services [5].

Any ICT intervention that boosts the lives of poor rural farmers will have vital present and incidental impacts on enhancing agricultural manufacture, advertising and post-yield movements, which in trend can assist to poverty reduction [6].

3. ICT HURDLES FOR RURAL AREAS

For all rural areas, the hurdles that demand to be discussed by broadband ICTs are:
1) Distance handicaps, i.e., access to administrative and government utilities and formats.
2) Fiscal handicaps, i.e., approach to deeper business and labor markets.
3) Communal walls of rural citizens' approach to information, literacy and coaching, health, social services, etc.
4) Traceability of manufacture, products and services throughout the price chain including logistics [7].

4. THE PROBLEM

Rural areas in Pakistan face a lot of related issues in the domains of agriculture, tourism, environmental care, economic, communications the framework, relatedness, water resources management healthcare, roads and transport, access to markets, health and literacy, which claims for related but locally relevant results to be guided towards solving issues associated with these similarities. In place to reply to the demands of the rural societies, alleviate starvation and tighten the digital divide between metropolitan and rural zones, this research suggests the approval of ICT, especially named IoT, in the distribution of utilities to rural societies of Pakistan. The aim of this analysis is to determine needs and recommend IoTs in return to these demands that will grant to easing the jolt of starvation in the rural areas of Pakistan, with attention on the agricultural zone.

The questions proposed are as follows:

- What are the agricultural demands of the rural societies that, when discussed will bring to the upliftment of their ways of life and poverty alleviation.
- What IoT technologies are in presence and what IoTs can in the outlook be shaped and established to reach these needs.

The research aspirations, therefore, will be:

- Review existing information on the agricultural demands in Pakistan.
- Identified IoT technologies that can discuss these demands through use case.

In place to sufficiently discuss the analysis dilemma, the analytical technique is adopted. The analytical method is based on qualitative techniques to gain and resolve statistics. It is vital in enforcing the investigator's awareness of individual attitude and action as it connects to the circumstance under research [8]. It's based on the assumption that knowledge of realism can be best gained through social development which consists of documents, shared definitions, etc [9]. An article the discussion was kept on both the agricultural needs/demands of the rural communities, and IoT technologies that can be suited to reach the needs/challenges. The final output is recommendations on IoT technologies for the territory of agriculture, considering exactly at results to the diagnosed needs.

5. AGRICULTURE OF PAKISTAN

According to the Asian Development bank 2017 [10] estimates, in 2011, 210 million people living in Pakistan, and of these, 12.4% Pakistanis live in poverty, reside in rural territories. Poor families in rural areas depend on a combo of subsistence agriculture, social endowments and aids from household members working in municipalities or mines and derive most of their earning from agriculture. IoTs would facilitate connection to agricultural supplies, recognition, and approach to markets for produce management of rural transport for farmers, communication with development services for information on agricultural practice and for information of weather forecasts to reduce agricultural risks. The Pakistani agricultural the region is diverse including crop conservation, horticulture, animal production, chicken production, forestry, dairy farming, fish farming, game farming, and agro-refining are launched. According to Usman M (2016), agriculture employs 63% of

Pakistan's are engaged in agriculture for 'own consumption' purposes [11]. IoT can be selected in the governance of agriculture, running track of animals in communal grazing lands, managing agro-processing industries, dealing with irrigation structures and transport logistics management. Over 90% of smallholder crop production in Pakistan is flood-fed, so rainfall is a pivotal cause for selecting crops, their planting time, the timing and anxiety of input and labor usage and subsequent yields [12]. IoT can be followed for weather forecasting because of the frailty of weather patterns and to relieve agricultural risks. In Pakistan, the fisheries zone, because of its essentially rural surrounding, survives to strengthen slightly to rural Improvement in terms of employment and revenue generation and diminishing poverty [13].

This creates huge opportunities in cold storage and shipment of fresh fish using refrigerated trucks and associated logistics using IoT. On the other hand, Afghanistan leaves a low number of rivers and dams which owned and organized by the government and they have less numb of fisher farmer that cannot produce enough fish for the demand of customers. As a result, Pakistan can be encouraging rural aquaculture for food care in public dams, IoT can be adopted in the supervision of aquaculture ventures. If we examine the livestock comparison both of between Pakistan and Afghanistan. We conclude that In Pakistan 46.1 million, 74.1 million and 30.5 million cattle, goats, and sheep, correspondingly, are found in smallholder farming structures or the conventional zone [13]. In Afghanistan livestock, the estimated contribution of communal areas to cattle, goats, and sheep is, 3.7 million, 7.3 million and 8.8 million respectively [14]. Livestock impact on GDP is also differently for both two developing countries. IoT can be taken up to preserve step of livestock specifically in rustic areas where there is communal grazing and animals are fair to bring lost. Below we make a table that can compare on livestock and its impact on GDP.[15,16] and it means we have much more population against Afghanistan but Pakistani agriculture system contribute a little bit low on GDP rather than Afghanistan and it could be improve if influence of technology increase in the agriculture sector of Pakistan .

Table.1. Livestock Comparison between Pakistan and Afghanistan

Livestock Comparison						
Country	Country's Population	Rural Population According 2016 Census Report	Population of Livestock (million)			Revenue impact on GDP
			Cattle	Goat	Sheep	
Pakistan	210 million	60.78%	46.1	74.1	30.5	11.4%
Afghanistan	37.2 million	72.87%	3.7	7.3	8.8	15%

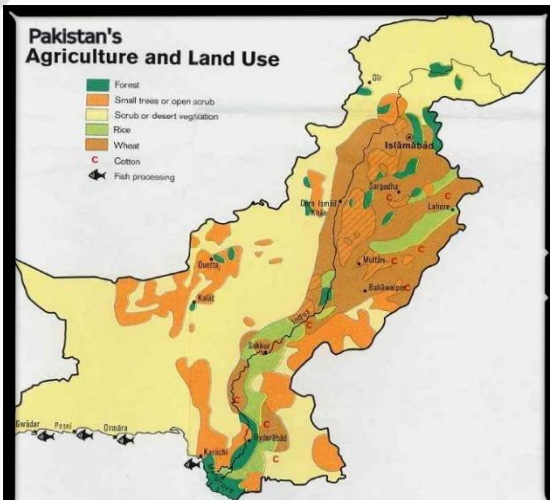

Fig.1. Map of Pakistan Agriculture and Land usage [17].

6. IOT IN AGRICULTURE

The subsequent sections provide a few lessons of potential functions of IoT in agriculture. For agricultural purposes and in an atmosphere where climate change arises in unpredictable rainfall patterns, automated drip, it can adopt irrigation. Drip irrigation is the crop watering technique that floods only the soil closest to the plant's roots. Linking data on temperature, radiation, moisture, and land water content raised by different sensors controls not solely where water is released but they need how frequent. Since the rural areas are endowed with renewable energy and there is rare or no approach to the electricity grid, these renewable electricity technologies such as solar and wind can feed power into water supplies that push water from underground into tanks. We run this water to irrigate crops.

We can make weather forecasting through analysis of weather data over later durations to diminish agricultural risk. It relates to this as a tremendous data investigation. Weather forecasts for pest management, moisture, drizzle, crop type, land fertility, leaf moisture, temperature, air, and soil humidity are collected at the local level through sensors. We control the life cycle of pests along with climate data, providing researchers to forecast pest outbreaks more precisely because virus maturation depends on natural conditions. To avoid stock theft, it fits animals with radiofrequency identifiers (RFIDs) that facilitate tracking of the animal. We can visualize the location of the animal on a map in a control center through data remitted wirelessly. In rural sectors where there is communal grazing, animals have misplaced. It fits livestock with RFID chips, and It places RFID readers at different monitoring spots to transfer information to an agricultural extension services center [18]. It can inquire about the location of the animal.

The IoT can yet enable branchless banking services. Farmers can collect, withdraw and transfer money, and pay bills from a network of agents that have retail stores to the praise of rural communities, who have no approach to banks within a reasonable distance. A regional price information system could gather data from the essential national markets and filter it out to the local level through small information centers that have Internet access. In more isolated states, paired way or rural radio can be adopted to spread market prices to broader audiences. Satellite light emission can find water pollution in the heavy skeletons of the flood. It runs the wavelength of poisons to analyze the class of poisons. This machinery would come helpful in aquaculture. Flooding is trouble in the river basins. A web site can be set up with an actual-time introduction of a river basin. The expertise to detect what is arising throughout a river basin and act rapidly to changing hydraulic and weather patterns can sustain an abundance of lives in agricultural communities. Sensors monitor the atmosphere in the river basin and wirelessly feed information into the website.

Veld fires are still an issue in rural areas. Satellite technology can be utilized to find fires through heat intensity sensors and photos that are transmitted wirelessly to the relevant locations. Trees can have plastic barcodes hammered into them, to forbid illegal logging of the coveted hardwoods. The sticker on the tree is scanned as shortly as the tree is cut, uploading the information via satellite to a reliable database. The database tracks the tree index and gives details. Trees can be tracked from the forest all the action through the supply chain to the consumer. Organic greenhouses use technologies such as sensors to supervise and adjust the temperature, moisture, soil aeration, soil humidity and sewerage, fertility levels and light.

The binding of these technologies with strategies to handle them can contribute to smart systems that do not help farmers effectively promote their reserves but still move to diversification where a spacious scope of crops can be grown. These organic greenhouses also cause electrical energy to work as hoped. The form of energy will grow from solar and wind electricity, therefore a system that integrates solar panels and wind turbines to sensors. The IoT technologies can support precision agriculture, a form of agriculture whose objective is to boost revenue on investment in agriculture. Irrigation/water, detection/soil detection sensors give signals to further defend a farmer's crop and deliver the information wirelessly to water reserve positions on when to irrigate. Farmers can use automated drip irrigation in sectors where water is sparseness. This can be achieved by joining data from different sensors that handle not solely where water is distributed but how often is required.

In place to reduce crop destruction by plant-eating pests, animals and veld fires among alternatives, better in-field monitoring is needed. This can be achieved by building sensors that supervise the fields. These will be easy to notify farmers of any attack on their crops or fires detected before they escalate. Numerous decision support systems that run on smartphones assist farmers to organize for the coming farming season. In these operations, farmers diagnose crop and livestock diseases and prescribe treatments to the identified diseases. Alternatively, in situations where a farmer visits several veterinary officers, villagers can get smart health cards. These cards can save all their animals' information and is renovate at every visit to the veterinary officer for telemedicine to rural

farmers, smartphones can be utilized to photograph and transfer images of affected livestock or crops to authorities who prescribe remedies to the problems analyzed.

Public agriculture surveillance programs enable decision-makers to handle agricultural interventions, such as prohibiting the flow of plants eating pests or other plant infections. Systems that use IoT technologies, record and control farm animals and recognize possible symptoms of infections. These technologies can be combined with a fundamental system and further disseminate relevantly advice to farmers. We can run this to describe outbreaks and trends. In addition, since livestock can be robbed, a system that scans them using GPS technology can be inserted in place to observe their movement and alarm the owners in case there are no detected animal movements for a precise period.

To simplify the distribution of farm products to their target, sensors that use IoT technologies such as GPS and RFID tracks and monitors farm products during transport and stockpile. Since rural communities are moderately occupied, identify suitable transport to transfer products to their proposed destination is a challenge. IoT systems can track farmers requiring transport to move their farm products to predetermined destinations. Satellite transmission can be made extremely convenient in rural areas. This can hook up to other areas via mesh technology. With this connectivity, rural farmers can have an approach to information on markets for their products and prices, government services and their rights. To promote the investment of farm inputs and selling of farm products, purchasers' and dealers' smartphones are furnished with IoT technologies such as Near-Field Communications (NFC) that helps the purchasing of commodities without using cash.

Electronic transactions that debit or credit bank accounts for purchasers and sellers instead change the transfer of cash such technologies also enable branchless banking services which is profitable to rural farmers who have no access to banks within a sensible distance. Mobile Internet and low-cost sensors could enable farmers to collaborate quickly with the consumers, cutting off the mediator. Pakistan has developed M-Pesa kiosks in the rural communities for mobile money transfer. Farmers visit these stalls for transactions with proceeds from selling within the society to pay for labor and inputs. Therefore, money circulates within the agricultural community [19].

7. RELATED LITERATURE

Although developed states have shifted the world in ICT use for over two decades, the latter decade has witnessed remarkable achievement in ICT usage by developing countries. The latter now possess the quickest increase in ICT penetration and associated productivity growth has surpassed that of established and transition countries. Today, public information and services that were challenging to approach a decade ago are freely available specifically to rural and marginalized people. In remote rural situations where communication would commonly have several weeks to accomplish, the arrival of mobile phones, instant short messaging system (SMS) and multimedia message system (MMS) has eliminated waiting periods to carry important judgments. Modernized ICT such as the Internet, email, personal digital assistants (PDA's), 3G, 4G, and 5G mobile phones, and social networking by means of Facebook, YouTube, etc. have enhanced communication borderline in the 21st century reaching previously excluded communities. These modern ICTs have enabled developing countries to "leap-frog" agriculture and agrarian development. As a result, enhancing awareness is being focused on the role ICT could perform in improving the approach to markets crucial to the achievement of agricultural commercialization, food preservation, and poverty alleviation in Pakistan [20]. Mobile phones may be used to increase revenue, boosting the efficiency of markets, reduce transaction costs and gives hope for interferences in service delivery [21].

Internet of Things (IoT) is a technology occurrence that is arousing the present situation and will influence the future context. IoT relates to constructing a chain of objects that convey with one another, via the Internet, integrating embedded sensors, RFID, GPRS, computers, actuators, mobile phones, etc. These objects have different addresses that facilitate them to address and find out their identities. Object swap and process information corresponding to specific tasks and transmitted details to users [22]. IoT capabilities of introducing objects through the internet can apparently, be utilized in agriculture in several scenarios. Several researchers discussed the need for IoT in agriculture to reinforce the various agricultural processes. Xiaojing and Yuangua (2012) [23] emphasize particularly the use of cloud-enabled systems to illustrate the relation between the information cloud and IoT from the point of view of agricultural data and its use cases. They suggest that intelligent agriculture is one of the applications of the Internet of Things (IoT), which has a comprehensive application and an excellent future.

ZigBee is a moderate-cost, low-power, wireless mesh networking standard [24]. The modest cost provides the technology to be extensively set up in wireless control and monitoring applications, the rough power-usage allows longer survival with smaller batteries, and the mesh networking provides high accuracy and a wider range. As a brand-new information gain and the processing technology, the ZigBee has seeped steadily into the agricultural environmental monitoring domain. The ZigBee technologies support the recognition of pests in the crops, aridity or increased moisture. Having such knowledge at a real-time interval, automated actuation devices can be utilized to handle irrigation, fertilization, and pest management in order to balance the unfriendly conditions. This technology can be referred to as wireless applications in agriculture. The ZigBee nodes can receive the temperature, moisture and illumination information in real-time, and later send to a remote monitoring center.

A survey performed by Joe-Air Jiang (2014) [25] indicates that precision agriculture has turned into a serious issue. Wireless sensor networks (WSNs) and IoT might be great weapons to observe environmental parameters and plant growth in agricultural applications because these two technologies can give high-resolution spatiotemporal sensing data extracted from real-life physical/analog signals. Precision agriculture is bothered with whole-farm management assisted by the ICT to optimize returns on inputs while saving resources with respects to crop science, environmental safety, and economics aspects. Thus, significant information can be presented in terms of farm record-keeping, enhance decision making, foster a greater traceability process and enhance the inherent quality and advertising of farm products.

Maumbe (2010) [20] gives a structure of the growth of ICT applications in agriculture and rural improvement based on comparative experiences of South Africa and Kenya. The framework postulates that the whole deployment of ICT in agriculture and rural development will be a culmination of several phases of innovations that lead to an e-government strategy plan, evolution, and implementation. The author claims that ICT use in agriculture and rural development is a dominant mechanism for promoting agricultural and rural development and standards of living throughout the whole poverty areas. However, success in the bigger industry of ICT in agriculture will demand to address barriers to endorsement and diffusion. Such flaws comprise the absence of awareness, low literacy, infrastructure failures (e.g. shortage of electricity to charge electronic gadgets), language and cultural difficulties in ICT management, the nominal e-inclusivity and the need to cater to the specific desires of some users. The work examines fruitful applications of ICT in agriculture and promotes higher use of ICT-based interventions in agriculture as a vehicle for rural progress in Asia.

8. ADVANTAGES OF IOT IN AGRICULTURE

This research describes and promotes a figure out of the requirements of Pakistan rural areas and what interventions it can give in terms of the IoT technologies. IoT technologies have the power to reduce poverty and raise up the standard of living of rural farmers. For illustration, organic greenhouses make it probable to produce a broad range of crops that can not only be consumed locally but deeply for transport to other countries. This permits farmers to produce extra revenue that serves to uplift their standard of living and significantly supports the gross domestic product (GDP) [26].

The rural farmers can further leverage investments in IoT technologies that support agriculture to raise the standard of living. For illustration, the tapped solar and wind energy can be significantly be utilized not merely to lighthouses but still to continue in contact with current affairs through radios and television sets. With IoT it is feasible to run public agriculture surveillance programs that enable decision-makers to guide agriculture interventions, e.g. to restrict the spread of plant-eating pests, alternative plant conditions or alerting farmers of veld fires approaching their fields. This assists farmers to adopt preventive actions before the situation goes out of control. Without such mediations, the government can consume lots of money on promoting the afflicted farmers. Precision agriculture can serve to bumper harvests even during times of drought. The governments will not consume several money importing agriculture products from other countries since the farmers will generate adequate farm products to feed the nations. Since IoT technologies encourage the tracking of harvest products all the path to their destination, this is excellent for farm products that involve further processing since the purchasers can know in advance when the farm products will take place and prepare for the next processing steps in time. Since rural communities are sparsely occupied, the shipment of farm products can be trouble [27].

IoT technologies can allow transporters by providing them with information about farmers who demand transport. Therefore, transporters do not desire to wait until they have a complete truckload of harvest products to lunch off, they can take off any time provided they are aware that there are farmers waiting for transport ahead [28]. Through the usage of Near-Field Communications (NFC),

the farmers and consumers can serve from paperless transactions and this helps minimize fraud and theft. Similarly, this is profitable for rural farmers who have no approach to banks within a proper distance to deposit cash from purchases or withdraw cash to purchase farming inputs. The value of livestock or crop smart health cards that keep information associated with affected livestock or crops can be favorable to both the veterinary or agriculture officer and the farmer. This can contribute to the efficient and adequate analysis and remedy of medication since the officer has access to all the historic information of the affected livestock or crop. If satellite communication is made possible in the acute rural area, this takes the potential to generate jobs for local businesses who could provide low-cost solutions, access, and wireless network services cheaper to the communities. Satellite transmission can still enable farmers in rural areas to achieve information on markets for their products and prices, government services that they can approach, and their rights. The systems can still join to government departments and local and global markets. With the introduction of the mobile internet and low-cost sensors, farmers could interact directly with buyers and biting off middlemen who usually handle them. This is valuable to farmers because they can do better profits on their products [29].

9. CONCLUSION

It is necessary to understand that farmers and agricultural laborers should not be considered as simple consumers of universal information and knowledge. The agricultural region demands a strong-established learning community in the shapes of IoT involvement with farmers' associations, women's groups, cooperatives, and many more that is more helpful in the progress of rural development. This research has analyzed potential applications of IoT in agriculture for sustainable rural development. It has shown the business benefits that can be derived from IoT by different domains of agriculture. These domains consist of weather forecasting, water management, wildlife management, finance, forestry, plant and animal disease management, storage and transport of agricultural supply, extension services, etc. The view indicates to regulate policy on the adoption of IoT in rural development and agriculture. The study can further be utilized by developers of modern IoT technologies to expand country-specific technologies based on the identified. Rural folk will progress when the technologies have been established to support poverty alleviation and improving the standards of the people.

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