EXPLORING THE AVENUES OF ADOPTION OF AGRICULTURAL UAVS BY THE SMALL -TO- LARGE LANDHOLDINGS FARMERS

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INTRODUCTION

Pakistan's agriculture plays a vital role in ensuring both the nation's food security and its national security. The Government of Pakistan has recently launched a significant initiative, establishing the Special Investment Facilitation Council (SIFC), with a particular focus on revitalizing key industries, including agriculture. Agriculture not only contributes around 22.9% to Pakistan's GDP but also engages approximately 37.4% of the total workforce in the country. The agriculture sector is facing several challenges which include issues such as poor seed quality and management, limited adoption of technology, a shortage of skilled labor, and the prevalence of small landholdings. Consequently, progressing the agricultural sector is essential to bolster Pakistan's fragile economy. To address these challenges effectively, the agricultural sector requires the implementation of efficient, sustainable, innovative, modern, and environmentally friendly approaches. These measures are crucial for bridging the yield gaps per acre between Pakistan and developed countries.

The introduction of Unmanned Aerial Vehicles (UAVs) is one of the latest additions in the Precision Agriculture gadgets to manage crop growth and quality efficiently. Spraying through UAVs is proven to be faster, efficient, effective, less laborious, and cost effective as compared to traditional technologies being used for agrochemical spraying (Moskvitch, 2015). Proper planning and management of targeting hotspots of weeds and pests through UAVs can minimize and save large amounts of unnecessary chemical applications. However, UAVs operators can easily position themselves outside the field and can avoid direct contact with pesticides. UAVs are also ultra-low volume (ULV) systems when compared to conventional spraying techniques. Therefore, they reduce the impact of chemical residues on nature and people compared to traditional spraying methods. Overall, adoption of UAVs could be farmer and end user friendly which could also result in improved soil fertility and minimal harmful impacts on human health.

Despite challenges, the long-term benefits of UAV adoption in precision agriculture outweigh the initial hurdles. With appropriate policy interventions, increased awareness, and investment in research and development, UAVs can play a transformative role in optimizing resource use, improving farm productivity, and ensuring environmental sustainability. As Pakistan strives to

modernize its agricultural sector under initiatives like the Special Investment Facilitation Council (SIFC), prioritizing UAV technology can serve as a key enabler in achieving precision agriculture goals. By addressing existing barriers and fostering an ecosystem conducive to UAV adoption, Pakistan can enhance food security, strengthen its agricultural economy, and move towards a more sustainable and technology-driven farming landscape.

This study aims to examine the factors influencing farmers' readiness to embrace agricultural UAVs, focusing particularly on three crops: Cotton, Sugarcane, and Maize. The choice of these crops is deliberate, as they require intensive spraying, which will further facilitate the development of UAV services/products. Additionally, the study seeks to offer valuable insights to policymakers for crafting a comprehensive strategy to establish and promote a national UAV policy for agriculture. To achieve this, a qualitative approach will be employed to pinpoint the key regulatory barriers impeding the advancement of the UAV market in Punjab. Thus, the study has three primary objectives:

1. Identify various constraints including regulatory constraints linked with the adoption of UAV technologies and their import.
2. Assess the willingness to pay of farmers to adopt UAV technologies for spraying purposes.
3. Present recommendations based on the study's findings.

METHODOLOGY

The study was designed to collect survey-based information from the major agricultural cities of Pakistan especially focusing on cotton belt of Pakistan (Multan, Rahim Yar Khan, and Khanewal). This selection was primarily motivated by the significant number of agrochemical applications required in these districts, ranging from approximately 8 to 10 during the cotton crops' growing season to mitigate pest and weed damage. Interviews were conducted with key stakeholders to gather comprehensive insights into the integration of UAVs in the agricultural sector. The stakeholders interviewed were private service providers, agrochemical companies, government institutions, national agricultural research centers, and agricultural universities in Punjab. The interviews explored various aspects such as the constraints faced in purchasing and importing UAVs, service delivery and pricing mechanisms, operational challenges and skill requirements, market limitations, and necessary improvements. Additionally, the interviews focused on input on governmental support needed, current policies and regulations, and the potential role of UAVs in enhancing agricultural productivity. Farmer surveys were also conducted in theselected districts of Multan, RYK, and Khanewal was visited, and surveys from cotton, sugarcane, and maize farmers. The sampling was semi-biased as both progressive and unprogressive farmers, small and large landholding farmers were targeted in these three districts. Additionally, farmers from each administrative unit were selected based on their proportional representation. A total of 228 farmers were interviewed during the study and focus of the questions was the availability of drones in the locality, willingness to adopt, willingness to pay, constraints and challenges faced by farmers, and how demographics such as age groups and literacy rates are affecting the adoption of UAVs.

RESULTS AND DISCUSSION

Interviews with stakeholders

A total of 15 stakeholders were interviewed during the study. This stakeholder feedback was crucial in identifying regulatory and policy hurdles, informing a robust policy framework for UAV integration, and evaluating the commercial viability and market development potential of UAVs in agriculture. Key Constraints and Challenges Identified:

(a) Policy Challenges

Major findings during the KIIs were the absence of national drone policy for agriculture. All stakeholders discussed that the difficulties in UAVs adoption at national level was mainly due to the challenges faced by these organizations in importing UAVs in Pakistan. All stakeholders were on board in terms of earliest availability of national drone policy. One of the interesting arguments made by a PSP was that easy documentation and approval process is mandatory during the policy development as the tedious policy could further discourage the UAV adoption. Another suggestion put forward by the Agriculture Department representative was the development of safe zones for UAVs operation that would reduce the unnecessary approval processes in the safe zones.

(b) Technical Awareness and Lack of Research

The very limited availability of UAVs for the research institutes are major limitation in creating the awareness among agriculture extension workers and PSPs. The representatives from research institutions, GoP representatives, and PSPs highlighted that more technical awareness is needed to increase adoption rate among farmers. Study conducted by PMAS-Arid Agriculture University (PMAS-AAUR) revealed that ROI of 2 to 5 years for more than 500 acres coverage per year. Preliminary findings of the research work conducted in few of the major crops are benefits in terms of labor savings and time saving between 10 to 40% depending on the sprayed acreage. One of the interviewees made an argument that research will strengthen the rapid technology transfer to the farmers.

(c) Famers Interests

The KIIs revealed that farmers showed high interest in adoption of the UAVs highlighting its cost and time-saving benefits. However, due to lack of infrastructure, current adoption rates are very low. Two PSPs highlighted that government subsidies and loaning will improve the overall adoption rates of the UAVs. However, PSPs informed that the willingness to pay varies from region to region and crop to crop. The price ranges from 400 to 2400 per acre per spray.

Famers Interviews

The use of Unmanned Aerial Vehicles (UAVs), or drones, is gaining recognition in agriculture for their potential to improve efficiency in crop monitoring, pesticide spraying, and overall farm management. However, the adoption of UAV technology in the agricultural sectors of Khanewal, Multan, and Rahim Yar Khan districts is still in the early stages. The survey conducted in these areas aimed to assess the awareness, adoption, and challenges surrounding UAV technology among local farmers. Results of farmer surveys revealed that awareness of UAVs technology is growing especially in young and more educated farmers. However, actual adoption remains low due to high

initial costs, high spraying costs, limited access to service providers, and lack of training programs. Smallholder farmers more inclined towards government subsidies or pay-per-use models. The study also highlighted farmers in areas with better exposure to technology showed a higher inclination toward adoption, while others showed their reliance on traditional methods. The major solutions to the highlighted challenges are development of a national UAVs policy for agriculture use, introducing service providers models, and integrating UAV training into educational programs. Addressing these barriers will be ensure successful wide-scale adoption of UAVs technologies in Pakistan's agricultural industry that will ultimately improve farm productivity and food security.

POLICY RECOMMENDATIONS

Following policy recommendations are necessary for adoption of UAVs in agrciulture among small-to-large landholdings famers based on key informant interviews (KIIs) and farmer surveys

1. Clear and well-structured national UAVs for agriculture use policy framework is needed. National UAVs policy should streamline the approval process covering all operational safety standards and legal concerns.
2. Approval process under one minitry and one application is required to reduce bureaucratic hurdles. Online application system for drone import, purchase, and operation could boost the UAVs use in Pakistan.
3. Financial assistance programs need to be introduced including subsidized loans and tax exemptions which will help farmers and service providers to afford UAVs technology.
4. Universities and research institutions need to play pivotal role in UAVs training centers to provide technical knowledge on UAVs use in different crops. TEVTA/NAVTC can also introduc short courses to train various age group farmers and service providers.
5. Collaborations between government institutions, private service providers, and agrochemical companies needed to be developed which will help in introducing affordable UAV service structure for smallholder farmers.
6. One of the major constraints in UAVs adoption is the access to UAVs in the local regions. Development of private or governmental UAV service hubs in key agricultural regions can increase the UAVs spraying among small scale farmers.
7. Agriculture extension department can play pivotal role in conducting targeted awareness campaigns through demonstration events to educate farmers on economic and environmental benefits of agricultural UAVs.
8. Establishement of local workshops for repair and assembling of UAVs is necessary to provide timely maintenance services and reduce reliance on expensive imports.

Implementation of these policy recommendations will boost the adoption rates of UAVs in Pakistan and overall precision agriculture technolgoies. Pakistan need to incorporate these technologies to ensure sustainable crop production and food security.