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Societal Behaviour and Agricultural Transformation in Pakistan China and Sri Lanka

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A B S T R A C T

The study was carried out to examine societal behavioural changes in the development of agriculture: Lessons from the Global Societal (Pakistan, China, and Sri Lanka). Improved food and quality production have been challenging in the supply chain. This paper draws on existing theories of behavioural change to construct a conceptual framework that explores pathways to initiate and sustain changes through the lens of empowerment. This research agenda has potential for providing valuable insights for policymakers, researchers, and stakeholders in agriculture and beyond. Both types of data were used for the work and attained using structured questionnaires through different sampling methods from rural farmers in the study area of Pakistan, China, and Sri Lanka. Recommendations were made for farmers within the study area to seek attitude and behavioural change for decisions in agricultural strategies. We argue that behavioural and social change needs to be clearly adopted in such endeavors to achieve better and longer-term outcomes for the people in the development of agriculture. Logistic managers preferred to use decision support systems to enhance approaches for confirming the demand for food quality and care. Public sector Agricultural Extension, academia (research institutions/universities), and stakeholders should launch massive campaigns to consider concrete ways to engage young farmers in agricultural policy processes and advocate for the active engagement of youth in the agricultural value chains.

Keywords: Behavioural change, Decision-making, Decision Support System, Rural farmers, Agricultural Development.

INTRIDUCTION

Innovation in agriculture refers to methods through which society introduces current or original products, procedures, and systems of organization into community and economic use to enhance efficiency, competitiveness, resilience to shocks, and ecological sustainability. In this way, innovation contributes to achieving food and nutrition security, economic growth, and sustainable natural resource management (Leeuwis *et al*., 2014). Given that many global sustainability issues are rooted in human behavior, one of the key challenges in navigating the path to a more positive future will be influencing the actions and choices of individuals and organizations (Jena and Behera, 2017; Steg and Vlek, 2009).

The success of any innovation adopted by clients depends on their preferences and the value they perceive from such innovations. Historically, farmers cultivated crops and raised animals primarily for survival. Over time, agricultural development has progressed through several phases, from Agriculture 1.0 to 4.0 (Figure 1) (Zhaoyu *et al*., 2020). Agriculture 1.0 refers to the traditional period of farming, which relied mainly on manpower and animal power. Agriculture 2.0 significantly improved productivity and efficiency through machinery and chemical use. Agriculture 3.0 emerged with the rapid development of information technology, where computer

applications and digital methods enabled more efficient and intelligent farming practices. In the current phase, Agriculture 4.0, innovations such as cloud computing, big data, artificial intelligence, remote sensing, and the Internet of Things are increasingly enhancing the efficiency and precision of agricultural activities.

According to Rogers (1995), adoption is the decision to make full use of an innovation, whether by an individual or a group, in a continuous manner. Adoption is influenced by several factors, one of which is the characteristics of the innovation itself. An innovation is perceived by the adopter based on their interests and personal needs, which are closely tied to their preferences. Individual preference is the choice that influences decision-making and drives the acceptability of new practices (Chavali and Prasanna, 2016). It can also be considered a person's attitude toward a set of options, typically reflected in clear decision-making processes (Lichtenstein and Slovic, 2006). Asrat *et al*. (2010) argued that environmental adaptability and yield stability are critical attributes for farmers when selecting a crop variety. Additionally, higher market value and greater income potential are among the main reasons farmers prefer certain innovations and adopt behavioral changes. Influencing behavioral change remains a central goal of environmental and agricultural sciences, including efforts in climate change mitigation and adaptation, biodiversity conservation, water resource management, and crop diversification. Yet, despite sound scientific evidence and good intentions, many projects have failed to stimulate or sustain long-term change.

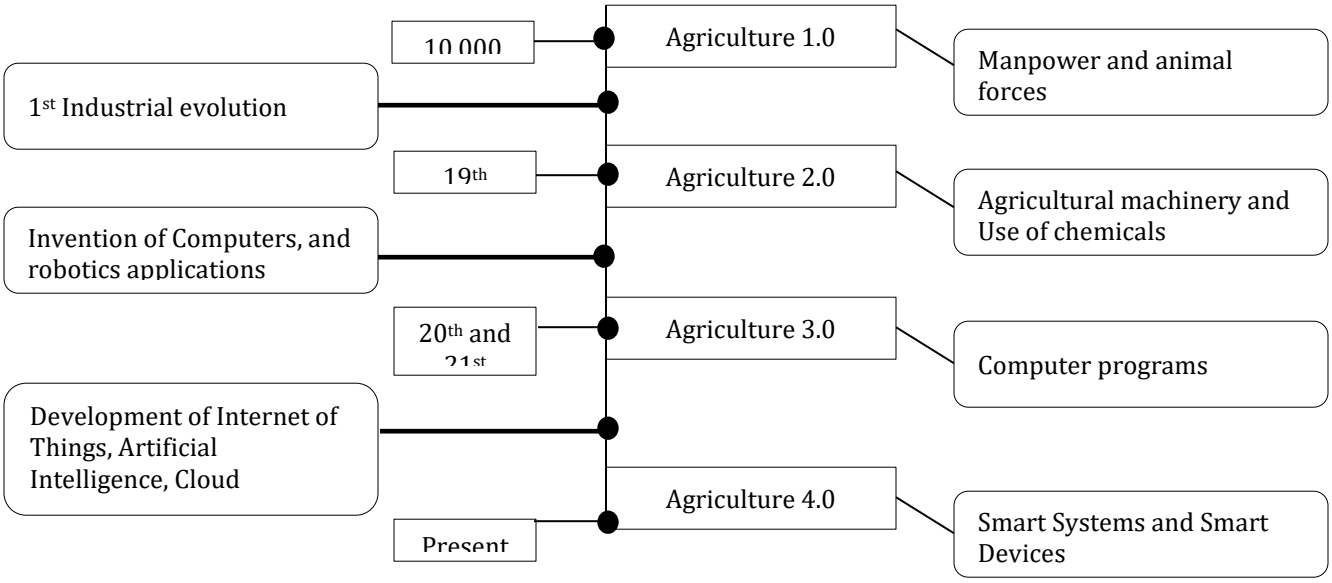

Figure 1. A general framework of an evaluation (Zhaoyu Shai *et al*., 2020).

Behavioural Change and Its Impact on Agricultural Development

According to the author, agricultural development and global ICT-related challenges for rural models highlight the possible effects of ICTs, infrastructure, and knowledge on societal change, as elucidated by Butt *et al*. (2017). Agricultural development is increasingly dependent on access to information resources and infrastructure compared to traditional rural development practices. Therefore, there is a growing risk of widening social, economic, and digital divides, not only between rural and urban regions but also across advantaged and disadvantaged areas.

Meanwhile, our focus is to understand behavioural change under technological facilitating conditions in agricultural information systems that take place within farming and rural communities (Figure 2). In this regard, Wolfert *et al*. (2017) provided a review on the use of big data in smart agricultural activities. At present, cloud computing technologies are being used to provide farmers with analytical insights into farming practices and to support effective operational decision-making.

Human behavior is complex and can be examined at multiple levels; therefore, numerous theories have been developed to explain behavioural change.

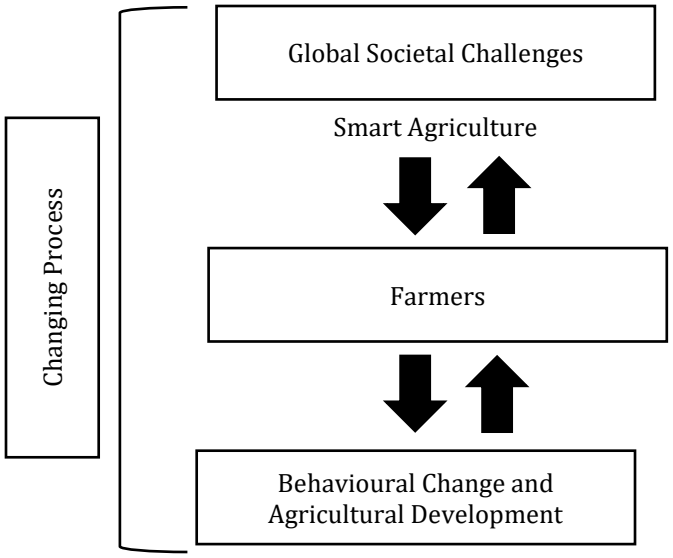

Figure 2. Smart Agricultural and Global Societal challenges (Butt *et al*., 2017).

Access to information and knowledge is as important for economic conditions as access to infrastructure. Awareness, learning, and training are becoming increasingly significant issues for economic influence and achievement. Communication systems are a key factor to reduce the cost of conveyance, increase competition, reduce market boundaries, expand farmer access, and in this way, directly improve and modify the performance of farm incomes and private investment opportunities.

According to normative beliefs, the cultural environment is the context in which a person lives and grows. In addition to cultural factors, specific non-cultural experiences in life, such as environmental conditions, may also motivate compliance. Motivation to comply refers to monitoring the perceived expectations of a specific social referent. In normative beliefs, motivation to comply is conceptualized at the level of the individual community referent. Expected outcomes relate directly to one's life prospects or program goals and objectives. What do you expect to achieve as an outcome of fulfilling your intentions? The impact of expected results or intervention activities may be evaluated by measuring changes in the identified behaviours. These changes are associated with knowledge, skills, and perceptions (Figure 3).

Human behavior is complex and can be observed at multiple levels; therefore, many theories exist related to behavior change (Davis *et al*., 2015). The conceptual framework presented in this article does not attempt to explain the full complexities of behavior change but instead offers insights on different ways to promote and support change. Self-efficacy, like perceived behavioral control, refers to a person's belief in their ability to perform a particular behavior (Eizen, 2002). This self-efficacy influences a person's choice of behavior and the effort they will make to persist in an activity when faced with difficulties. Self-efficacy develops from four main sources: (i) achievements in work based on personal experience, (ii) indirect experience through observing others performing the activity, (iii) verbal persuasion by others, and (iv) stress or other emotional conditions that affect the assessment of effectiveness.

Decision Support System and Its Impact on Agricultural Development

Behavioural approaches focus on the nature of farmers' decisions and the many factors that influence those decisions. Through questionnaire surveys in relevant areas, farmers' goals and values, as well as factors influencing their farm choices, were investigated. Many researchers have expressed different viewpoints. Jones (1980) defined a decision support system as "a computer-based support system for decision makers who deal with semi-structured problems to improve the quality of decisions." Researchers have clarified that a smart system within a community information system enables decision-making actions and provides support tailored to specific demands and challenges based on collected data. Enhancing knowledge sources helps identify the most effective methods for avoiding food waste. A decision support system can be aimed at providing growers with different options to associate their decisions under varying

conditions. This computer-based system is not only capable of delivering options for ongoing actions but can also help decision makers achieve improved performance in future tasks (Alenljung, 2008). The overall framework for the agricultural decision support system covers agricultural planning, water resource management, climate change adaptation, and food waste control. Agricultural data should first be collected and then used as input for decision-making modules. Instructions for managing agricultural activities are prepared based on the results of these calculations. Farmers may then choose the most suitable solution to address the problem. It should be noted that restrictions must be considered to ensure the quality of recommendations.

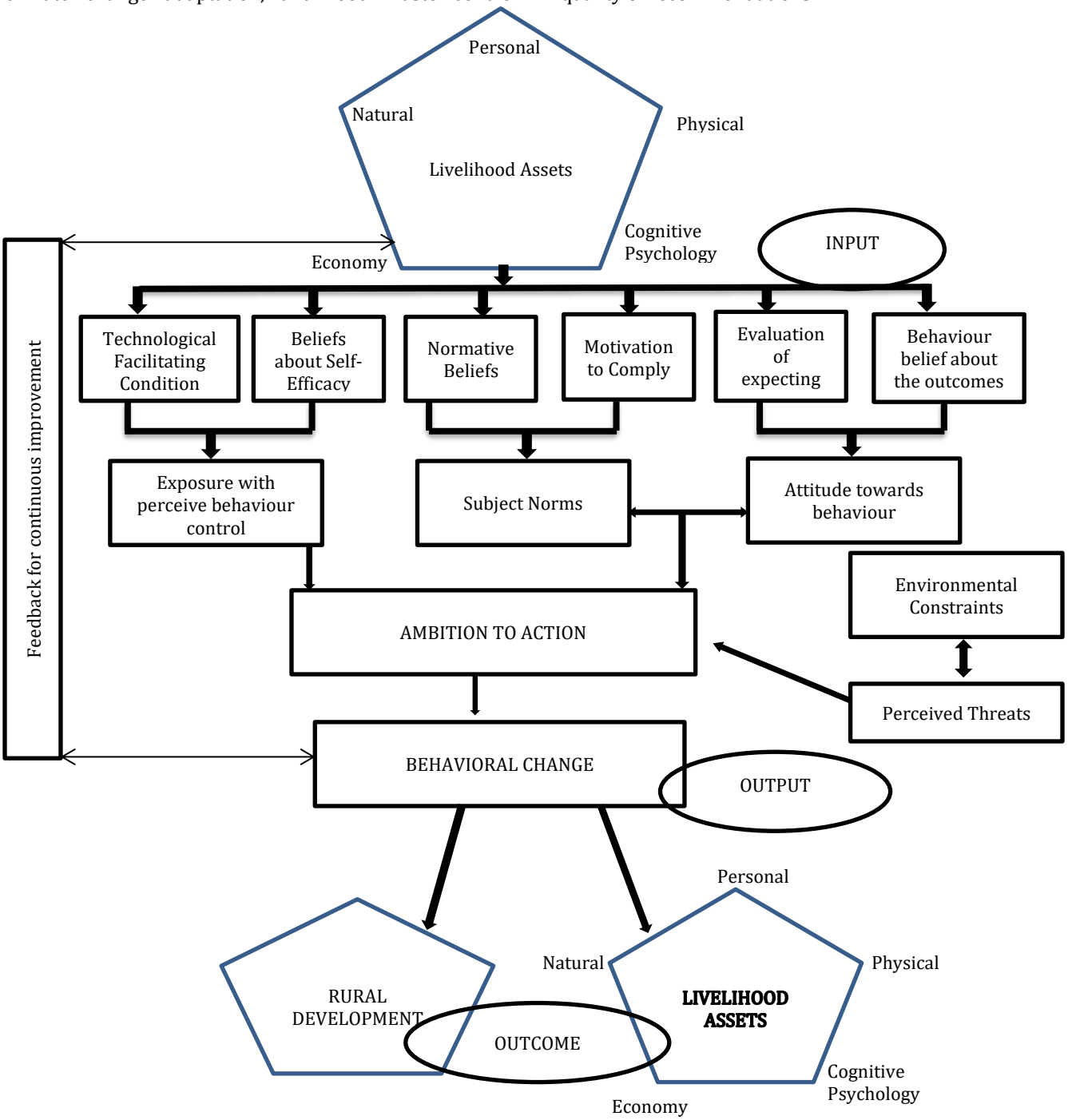

Figure-3. A conceptual outline describing the process of revolution through empowerment (with core concepts in boxes) decision to make change ultimately leading to the final outcome. (2023-Author's Conceptual Framework).

Agency is rooted in one's belief that they possess the power to make things happen, which is critical for exercising control over decisions of change. Self-efficacy is often considered the foundation of agency (Bandura, 2000). With a better understanding of the behavior change process, we argue that interventions can be more effectively designed if they target the least developed concepts and consider pathways of impact. For example, experiential learning not only increases human capital by expanding knowledge but also strengthens self-efficacy and agency. Designing interventions with the process of change in mind, as described in the framework, can help ensure that interventions are implemented more effectively and sustain positive outcomes for communities and their environments.

METHODOLOGY

The nature of this research was that of a field study conducted in Pakistan, China, and Sri Lanka. The study collected both primary and secondary data. Primary data were collected using a structured research tool (meeting schedule). For this purpose, individual interviews were conducted with farmers in the target research areas of all three countries. Prior to data collection, the reliability and validity of the research tool (meeting schedule) were measured. A pre-test method was used to determine reliability. Given the complex nature of the study, both probabilistic (simple random) and non-probabilistic (purposeful/convenient) sampling procedures were adopted. The content and consistency of the tool were evaluated by experts including Dr. Badar Naseem Siddiqui (Associate Professor, Chairman, Department of Agricultural Extension, PMAS Arid Agricultural University, Rawalpindi, Pakistan) and Dr. Muhammad Luqman (Associate Professor, Department of Agricultural Extension, University of Sargodha, Pakistan).

Secondary information was obtained from books, research journals, national and international conference/symposium materials, dissertations, and research reports from past projects. The use of multiple data collection strategies provided the researcher with maximum opportunity to obtain accurate responses from respondents on specific issues (Acharya *et al*., 2005; Tucker *et al*., 2005). A three-point Likert scale (always, sometimes, never) and a five-point Likert scale (independent decision, decision with housewives, decision with relatives, decision with specialist/experienced farmers, and no decision) were used to measure the degree of agreement with different statements. The collected data were coded and analyzed using Microsoft Office Excel and SPSS version 20. Both descriptive and inferential statistical methods were employed.

Pakistan

In Pakistan, Punjab Province was identified as dynamic in presenting the latest technology transfer to the farming community (Government of Pakistan, 2023). Punjab was purposively selected as the study province. Due to time and resource constraints, the study was restricted to two randomly selected regions within Punjab. For choosing potential respondents (farmers) from the selected two districts, a convenient sampling technique was used. From each district, seventy-five (75) respondents were selected, making the total sample size of the study 150 farmers.

Sri Lanka

In Sri Lanka, there are three major agro-climatic zones: dry, wet, and intermediate. The dry zone is the main agricultural region of the country. Provinces such as North Central, Wayamba, Uva, Southern, and Eastern are ranked as major agricultural areas. Based on these rationales, all districts within the above-mentioned provinces were purposively selected as the study area. Due to time and resource constraints, the study was restricted to one or two randomly selected districts from each province, with a total of seven districts. From each district, 20 to 30 samples were collected proportionately to the population, making the total sample size 130. However, ten interview schedules were removed due to incomplete information, leaving 120 valid responses.

China

The selection of the research site in China was based on two factors: the administrative unit and the main industrial structure of the site. Panggezhuang Town, located in the southern part of Beijing, was selected to represent the basic characteristics of Chinese villages. Panggezhuang belongs to the township-level administrative unit and is famous for its watermelon industry. With nearly 30,000 hectares of watermelon cultivation each year, the annual output reaches about 80 million kilograms. Two villages, Liuminzhuang and Xiaozhuang, under Panggezhuang Town, were selected for distributing questionnaires. A total of 130 questionnaires were distributed randomly; 120 were returned, and 115 were deemed valid. The resident population of the villages exceeds 800, but due to the

siphon effect of urbanization, most young men migrate to urban areas for work, leaving women and the elderly as the main operators of agricultural activities.

RESULTS

Table 1 shows the percentage distribution of the population in Pakistan, China, and Sri Lanka according to their level of education. In Pakistan, the majority of respondents had education up to Matric (38.4%), followed by F.A/F.Sc certificate (30.5%), primary to middle (11.3%), B.A/B.Sc (10.6%), Master's (9.2%), and diploma (0.0%). In China, the majority had primary to middle education (38.4%), followed by F.A/F.Sc certificate (15.2%), B.A/B.Sc (9.5%), Master's (7.9%), and diploma (2.6%). In Sri Lanka, most respondents had education up to Matric (41.7%), followed by F.A/F.Sc certificate (19.2%), B.A/B.Sc (17.2%), primary to middle (10.6%), Master's (2.6%), and diploma (0.7%).

Overall, the table suggests that education levels in the three countries are relatively low, with most respondents having education up to Matric. However, there are some differences across countries: Sri Lanka had a relatively higher proportion of respondents with university education (B.A/B.Sc), while Pakistan and China had larger proportions with Matric-level education.

Table 1. Distribution of respondents according to their education.

Education	Percentage		
	Pakistan	China	Sri Lanka
Illiterate	0.0	07.9	07.9
Primary –Middle	11.3	18.5	10.6
Ninth to Matric	38.4	38.4	41.7
F.A/F.Sc (certificate)	30.5	15.2	19.3
B.A/B.Sc (Bachelor)	10.6	09.5	17.2
Master	09.2	07.9	02.6
Diploma (please specify specialty)	0.0	02.6	00.7
Total	100.0	100.0	100.0

Table 2 shows the percentage of land holdings in Pakistan, China, and Sri Lanka classified into three categories based on size: small (up to 12.5 acres), medium (12.5–25 acres), and large (above 25 acres). According to the table, in Pakistan, 30.2% of land holdings are small, 44.0% are medium, and 25.8% are large. In China, by contrast, the vast majority of farmers fall into the small category, with 97.0% of land holdings classified as small. In Sri Lanka, 90.7% of land holdings are small, 8.0% are medium, and only 1.3% are large.

The table highlights significant differences in land distribution patterns across the three countries. In Pakistan, land holdings are more evenly distributed across the three categories, with a relatively higher proportion of medium-sized holdings. In contrast, in both China and Sri Lanka, the overwhelming majority of land holdings are small. These differences in land distribution may be attributed to several factors, including historical land ownership patterns, government policies and regulations, and broader socio-economic conditions.

Table 2. Distribution of respondents according to their Land.

Land holding	Pakistan	China	Sri Lanka
Small (up to 12.5)	30.2	97.0	90.7
Medium (12.5-25)	44.0	03.0	08.0
Large (above 25)	25.8	00.0	01.3
Total	100.0	100.0	100.0

Table 3 shows the distribution of land tenure types in agriculture in Pakistan, China, and Sri Lanka. In Pakistan, out of the total land tenure, 25.2% is owned by farmers, 35.8% is under tenants, and 39.0% is under owner-cum-

tenant. In China, 47.7% is owned by farmers, 13.9% is under tenants, and 38.4% is under owner-cum-tenant. In Sri Lanka, 89.4% is owned by farmers, 4.7% is under tenants, and 5.9% is under owner-cum-tenant. The owner tenure type is the most dominant in Sri Lanka, whereas in both Pakistan and China, the owner-cum-tenant type is the most common. Tenant tenure is relatively low in all three countries.

Table 3. Distribution of respondents according to their Type of Tenure.

Type of tenure	Pakistan	China	Sri Lanka
Owner	25.2	47.7	89.4
Tenant	35.8	13.9	04.7
Owner-cum-Tenant	39.0	38.4	05.9
Total	100.0	100.0	100.0

Table 4 shows the sources of agricultural information used by farmers in Pakistan, China, and Sri Lanka. Each country has a different percentage of farmers who rely on various sources of information. Decision-making behaviour is an important psychological parameter that determines the participation of rural youth in farming. In Pakistan, the most commonly used sources of agricultural information are progressive farmers (69.7%), followed by radio, TV, and print media (55.0%), friends/neighbours (36.4%), NGOs (38.4%), computer/internet facilities (32.9%), agricultural officers (27.8%), senior farmers (22.9%), and universities/research institutes (12.2%). In China, the most commonly used sources are universities/research institutes (82.8%), followed by computer/internet facilities (66.2%), NGOs (66.9%), radio, TV, and print media (62.3%), progressive farmers (58.3%), senior farmers (60.9%), agricultural officers (68.2%), and friends/neighbours (38.4%). In Sri Lanka, the most frequently used sources are NGOs (69.5%), followed by universities/research institutes (40.4%), senior farmers (39.1%), progressive farmers (43.0%), radio, TV, and print media (21.9%), agricultural officers (27.7%), friends/neighbours (13.9%), and computer/internet facilities (25.1%).

Table 4. Distribution of respondents to aware and utilization pattern of various source of information for agricultural activities.

Sources of agricultural information for agricultural activities	Pakistan	China	Sri Lanka
Agricultural Officer	27.8	68.2	27.7
Computer/Internet facility	32.9	66.2	25.1
Friends/neighbour	36.4	38.4	13.9
NGOs	38.4	66.9	69.5
Progressive Farmers	69.7	58.3	43.0
Radio, TV, Print Media	55.0	62.3	21.9
Universities/Research Institute	12.2	82.8	40.4
Senior Farmers	22.9	60.9	39.1

Table 5 shows the level of participation of rural farmers in various farm operations in Pakistan, China, and Sri Lanka. Mean scores indicate participation levels, with higher scores reflecting greater participation. In Pakistan, farmers reported the highest participation in shifting cultivation (2.815), followed by irrigation (2.457) and nursery bed preparation (2.397). The lowest participation was in fertilizer applications (1.497). In China, the highest participation was in dairy farming (3.000), followed by intensive subsistence farming (2.364) and nursery bed preparation (1.649). Fertilizer application had the lowest participation (1.252). In Sri Lanka, the highest participation was in livestock ranching (2.407), followed by dairy farming (2.360) and marketing (2.047). Fertilizer application again had the lowest participation (1.280). Overall, participation in farm operations varies across the three countries, reflecting differences in farming practices, cultural traditions, and government policies.

Table 5. Distribution of respondents to what extent of participation of rural farmer in farm operations.

Participation of rural farmers in farm operations	Events of Participation		
	Pakistan	China	Sri Lanka
	Mean	Mean	Mean
Nursery bed preparation	2.397	1.649	1.800
Transplanting	2.179	1.305	1.680
Ploughing	2.358	1.338	1.520
Sowing	2.318	1.291	1.487
Fertilizer applications	1.497	1.252	1.280
Weeding	2.079	1.318	1.440
Irrigation	2.457	1.351	1.307
Plant Protection Measures	1.861	1.404	1.700
Harvesting	2.199	1.325	1.320
Storage	2.172	1.411	1.647
Marketing	2.086	1.411	2.047
Livestock Ranching	2.119	1.536	2.407
Mixed Farming	2.252	1.517	2.060
Intensive Subsistence Farming	2.424	2.364	2.313
Dairy Farming	1.815	3.000	2.360

Table 6 and Figure 4 show the percentage of respondents in Pakistan, China, and Sri Lanka who possess knowledge and attitudes about pesticide use in agriculture. The categories include knowledge about targeted insects, recommendations for use, perceived cost-effectiveness, availability at purchase points, and awareness of warnings and precautions on labels. Respondents demonstrated varying levels of awareness. In Pakistan, 51.7% believed pesticides are inexpensive, while in Sri Lanka only 37.7% held this view. In China, 47% believed pesticides are readily available for purchase. Awareness of warnings and precautions on labels was relatively high in all three countries: 85.4% in Pakistan, 72.2% in China, and 28.5% in Sri Lanka. This indicates generally good awareness of the risks associated with pesticide use.

Table 6. Distribution of respondents to what factors in knowledge and attitude for purchasing pesticides.

Knowledge and Attitude	Pakistan	China	Sri Lanka
Which type of insect	27.2	17.9	13.2
Recommendations-How to use	33.8	40.4	15.2
Being inexpensive	51.7	60.3	37.7
Availability of pesticides in place of Purchase	13.2	47.0	19.2
Warnings and precaution on labels of pesticides	85.4	72.2	28.5

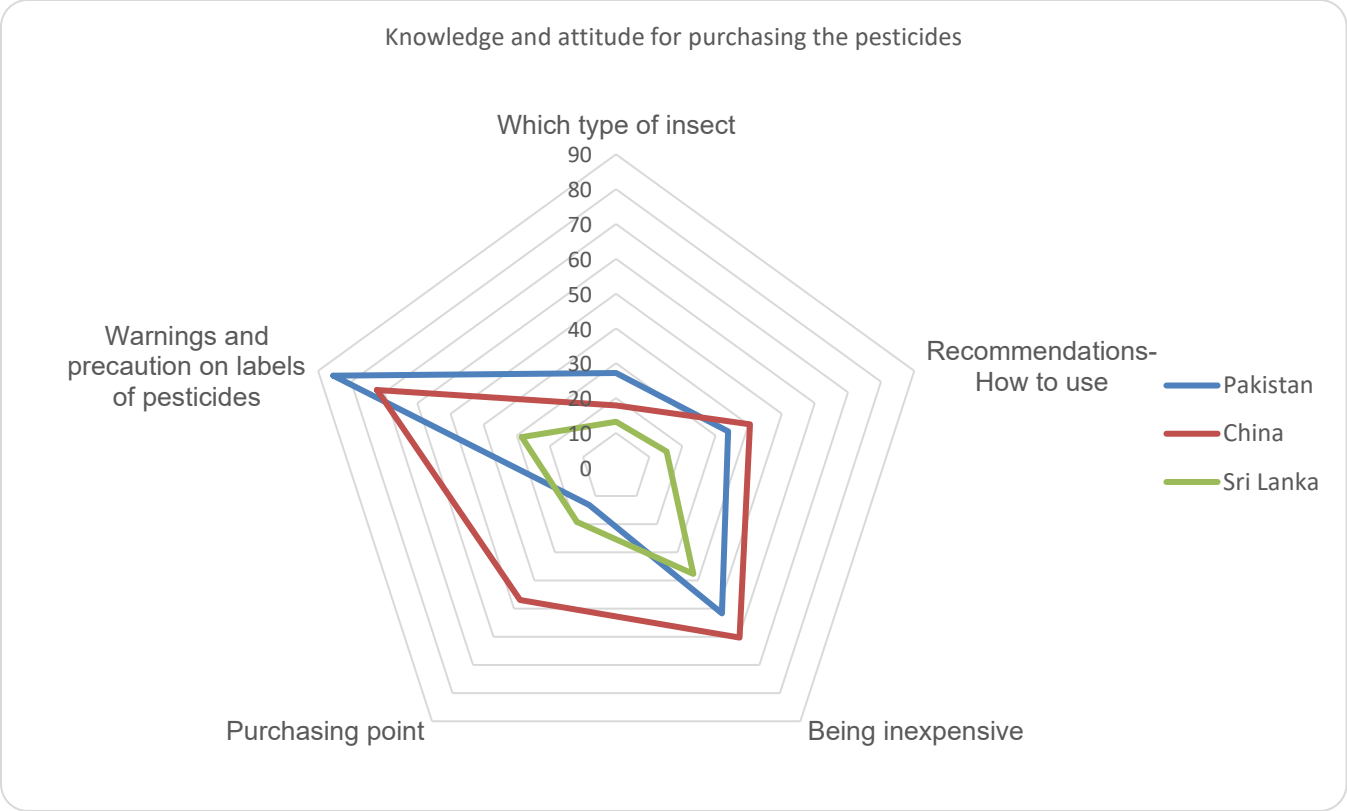

Figure 4. Respondents to what factors in knowledge and attitude for purchasing the pesticides.

Table 7 presents results of a regression analysis examining the relationship between demographic attributes and agricultural development in Pakistan, China, and Sri Lanka. In Pakistan, age had a positive and significant effect on agricultural development (coefficient = 0.109, $p < 0.05$), indicating that older farmers are more successful. Education was not a significant predictor (coefficient = 0.706, $p > 0.05$). Tenure had a positive and significant effect (coefficient = 0.527, $p < 0.01$), and land holding was a positive but non-significant predictor (coefficient = 0.653, $p > 0.05$). In China, age was not significant (coefficient = 0.034, $p > 0.05$), but education had a positive and significant effect (coefficient = 0.139, $p < 0.05$). Tenure was not significant (coefficient = 0.405, $p > 0.05$), and land holding had a positive but non-significant effect (coefficient = 0.404, $p > 0.05$). In Sri Lanka, age had a negative and significant effect (coefficient = -0.653, $p < 0.001$), suggesting older farmers are less successful. Education had a positive and significant effect (coefficient = 0.095, $p < 0.01$), tenure was significant (coefficient = 0.321, $p < 0.05$), and land holding was positive but marginally significant (coefficient = 0.221, $p < 0.05$). These results show that the relationship between demographic factors and agricultural development varies across countries, underscoring the importance of local context when designing interventions. Behavioural change interventions, such as education programs and sustainable farming practices, may produce different outcomes depending on which demographic factors are most influential.

Table 7. Impact of demographic attributes on extent of participation of rural farmers in farm operations.

Demographic attributes	Pakistan			China			Sri Lanka		
	Coeff.	Wald	Sig.	Coeff.	Wald	Sig.	Coeff	Wald	Sig.
Age	0.109	1.210	0.031*	0.034	0.005	0.944	0.653	0.725	.000**
Education	0.706	0.800	0.732	0.139	1.720	0.015*	0.095	0.400	.008*
Tenure	0.527	3.901	0.008**	0.405	0.246	0.620	0.321	1.532	.027
Land holding	0.653	0.321	0.571	0.404	0.824	0.041*	0.221	9.743	.031

*Dependent variable: Extent of participation of farmers in farm operations

**Independent variables: age, education, tenure, land holding*

Figure 5 represents the percentage of respondents in Pakistan, China, and Sri Lanka who reported experiencing various health problems related to pesticide use in agriculture. The results show that the most commonly reported health problems across all three countries were diarrhea, dizziness, and eye irritation. Pakistan recorded the highest percentage of respondents reporting abdominal pain, nausea, and skin redness/itching, while China had the highest percentage reporting respiratory distress and vomiting. Sri Lanka showed the lowest percentages for all health problems except diarrhea and skin redness/itching.

When interpreted in relation to behavioural change and agricultural development at the global level, these findings highlight the importance of safe and responsible pesticide use in agriculture. They also emphasize the need for education and awareness campaigns targeting farmers, farm workers, and the general public about the potential health risks associated with pesticide exposure. Governments and international organizations should promote and enforce strict regulations on pesticide use, including the provision and adoption of protective equipment, as well as guidelines for proper handling and storage.

Furthermore, there is a pressing need for research and development of alternative and sustainable pest management methods to reduce reliance on chemical pesticides. Overall, the findings underscore the importance of a holistic approach to agricultural development—one that integrates economic benefits with health and environmental considerations.

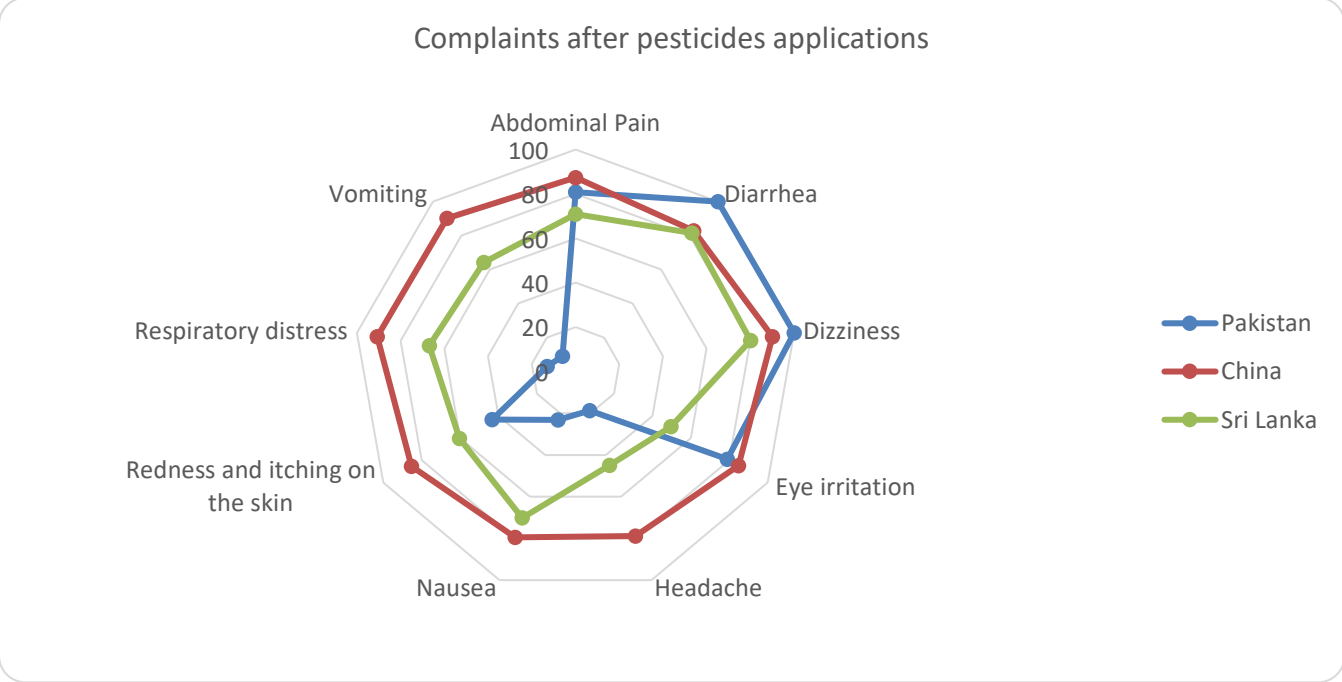

Figure 5. Respondents to which type of complaint experience after pesticides applications.

Figure 6 represents the constraints faced by farmers in Pakistan, China, and Sri Lanka across various aspects of agriculture. The percentages indicate the proportion of farmers in each country who reported facing a particular challenge. In Pakistan, 47.7% of farmers reported difficulties in purchasing inputs such as seeds, fertilizers, and pesticides, compared to 70.9% in China and 19.9% in Sri Lanka. Access to local markets or facilities for selling products was a challenge for 58.3% of farmers in Pakistan, 53.0% in China, and 24.5% in Sri Lanka. Similarly, 58.5% of farmers in Pakistan faced challenges in accessing farm equipment and inputs, while the figures were 63.6% in China and 29.1% in Sri Lanka.

Health and nutrition concerns were reported by 35.8% of farmers in Pakistan, 77.5% in China, and 30.5% in Sri Lanka. Access to experienced farmers or experts for guidance was limited for 16.6% of farmers in Pakistan, 51.0% in China, and 37.1% in Sri Lanka. In terms of training and capacity-building opportunities, 75.5% of farmers in Pakistan reported difficulties, compared to 39.1% in China and 34.4% in Sri Lanka. Opportunities for knowledge sharing were also limited, with 77.5% of farmers in Pakistan, 60.3% in China, and 34.4% in Sri Lanka reporting this challenge. Finally, access to agricultural information and technologies was cited as a constraint by 89.1% of farmers in Pakistan, 50.3% in China, and 40.0% in Sri Lanka.

In summary, the figure shows that farmers in all three countries face multiple challenges, but the type and extent vary significantly across contexts. These findings highlight the need for tailored support, policies, and resources to address country-specific constraints and to enhance agricultural productivity and farmer livelihoods.

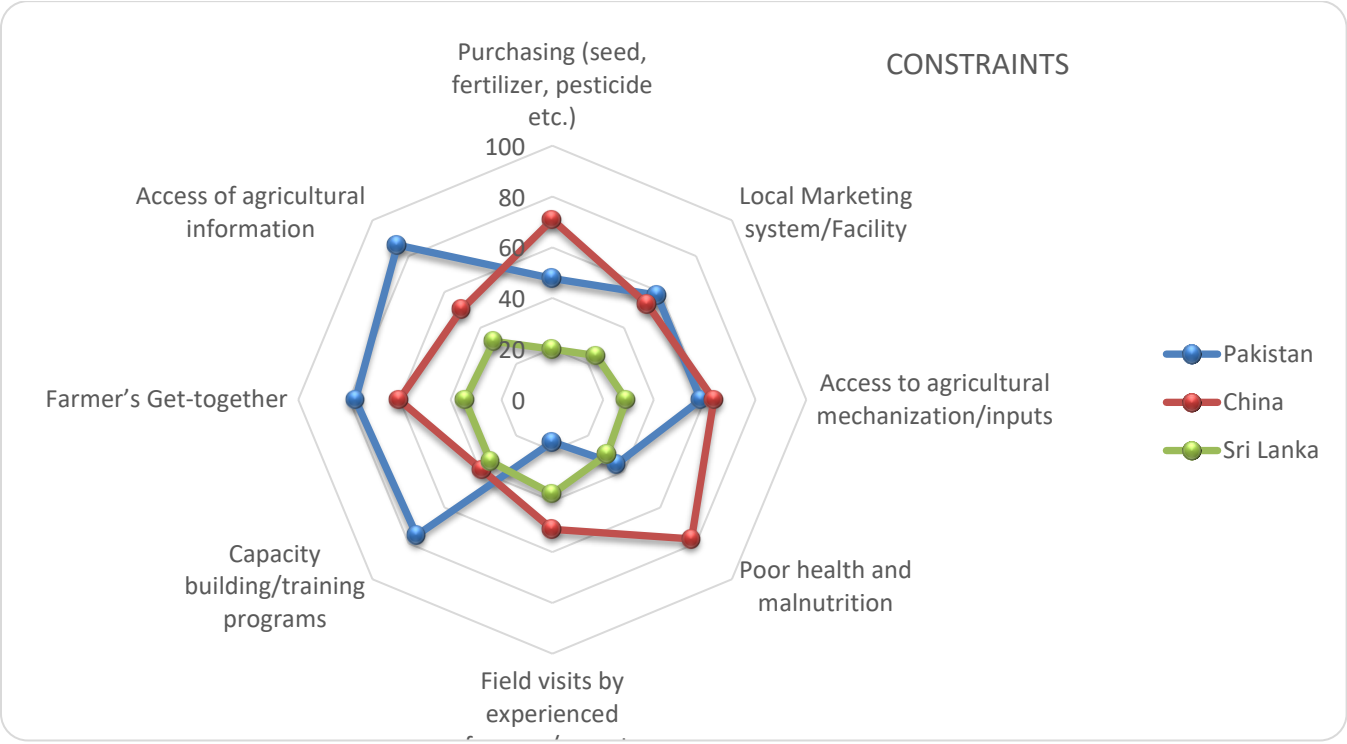

Figure 6. Respondents to what are the constraint faced by farmer.

DISCUSSION

Flow of Agricultural Information and Participation in farm Operations

Farmers want immediate, affordable, and modern agricultural knowledge to improve production. Shortages of information and awareness regarding purchases, product data, environmental conditions, credit opportunities, and especially marketplace prospects are major shortcomings in the agricultural system. With current rural developments, there is a dire need to steadily increase agricultural production through methods that allow large groups of people to be reached in a limited time, while changing farmers' behaviour to support agricultural development. This is essential to

provide adequate food for a steadily growing population, eradicate rural poverty, and ensure sustainable livelihoods (Chahal *et al*., 2012). Technologies such as mobile phones, wireless tools, and the internet provide important platforms for farmers to increase productivity (Awuor *et al*., 2016; Syiem & Raj, 2015). Modern agricultural production and protection techniques developed by scientists are essential to reduce disease losses and control insect pests effectively. In these circumstances, technology provides timely evidence for decisions on implementing good agricultural practices (Butt *et al*., 2017; Arfan *et al*., 2013). Farmers can use such information to improve production, increase market access, and operate efficiently with secure financial transactions (Thanuskodi, 2010). New crop varieties, planting methods, timely information on disease prevention, and opportunities for skill development enable farmers to take an active role in decision-making (Mukherjee, 2011).

Information and Knowledge as Tools for Decision-Making (DSS) of Rural Youth Farmers

Agricultural decisions about soil preparation, planting, weeding, irrigation, harvesting, storage, and marketing have always been a priority for stakeholders. In smart agriculture, farmers also need updated techniques, intercultural cultivation practices, fertilizer applications, micronutrient management, and related information (Ferroni & Zhou, 2012). Research shows that farmers sometimes make poor decisions due to lack of awareness, technology information, or capacity. At such critical stages, farmers often resort to cultivating crops without informed guidance, which can result in significant losses. Smart agriculture has the potential to address these challenges and enable timely decisions (Nwachukwu *et al*., 2011). ICT tools such as kiosks or e-Choupal have improved market access, revenues, negotiation power, and marketing options (Kaur *et al*., 2014). The National Information Centre of India (NIC) found that mobile technologies enabled farmers to access market information through SMS or voice call applications (Ganeshagouda *et al*., 2013). Most farmers now use technology for production advice, consulting, credit services, harvesting, and record-keeping (Hassan *et al*., 2008; Pickernell *et al*., 2004). ICTs also provide poor farmers with crucial marketing information (UN & ADBI, 2004). Mittal and Mamta (2012) found that farmers use ICT to learn about market prices and demand. Without such data, farmers are unable to take advantage of opportunities (Oyeyinka & Bello, 2013).

Attitudes and Behaviour of Rural Youth Farmers

Farmers' perceptions of new technologies, and the role of ICT in shaping attitudes, are critical. Timely access to information increases farmers' capacity to adopt improved practices. Ganeshagouda *et al*. (2013) reported that a large majority of respondents (96.36%) benefited from cyber-extension services in rural areas, which provided timely agricultural information, better marketing options, ICT services, and knowledge updates. Such access improved decision-making, product quality, and profitability. Behavioural change regarding pesticide use in agriculture can also significantly influence agricultural development. Rural youth farmers can be encouraged to adopt sustainable practices such as integrated pest management (IPM), which reduces reliance on synthetic pesticides. Promoting natural pest control methods helps reduce negative impacts on human health, the environment, and beneficial organisms. Educating farmers on alternatives can enhance agricultural productivity while mitigating pesticide risks. The aspirations of rural youth—educational, occupational, economic, social, and career-related—also play a critical role in their participation in farming.

Obstacles and Constraints Faced by Farmers and Extension Officers

Agricultural production often suffers due to weak government strategies, adverse weather conditions, lack of funding, poor capacity building, and limited access to marketplace information. Modern agricultural technology transfer tools need to be simplified and made more accessible, especially with the rise of cyber-extension mechanisms. Tanko *et al*. (2013) highlighted the difficulties associated with data and ICT use in agriculture. Butt *et al*. (2017) also identified constraints including weak infrastructure, lack of education, insufficient knowledge and skills to manage technologies, outdated materials, and irregular updates. These findings are consistent with Jamwal and Devanand (2011), who argued that problematic program structures hinder the effectiveness of ICTs. Similarly, Rasekhi *et al*. (2015) reported that poor knowledge, limited information, and lack of capacity building are major obstacles to farmers' decision-making.

CONCLUSION AND SUGGESTIONS

The study revealed a moderately favourable disposition among rural youth towards farming activities. Special

efforts should be made to attract, train, and retain youth in agriculture by making it more profitable and professional through scientific interventions and agribusiness opportunities. Behaviour change interventions must consider the different stages of readiness among farmers: those unaware of problems require different support than those motivated but facing obstacles. Estimating the distribution of farmers across stages of change—via baseline surveys of awareness, motivation, attitudes, self-efficacy, and resources—is crucial to design effective interventions.

Researchers and practitioners must also identify gaps in knowledge, resources, and capacities within target groups. The most effective interventions will depend on specific contexts but should focus on building self-efficacy, social networks, and general capacities beyond narrow technical issues. Such holistic approaches ensure long-term positive outcomes for both communities and the environment.

Agriculture remains a critical sector despite shrinking resources, as global food demand is projected to increase by more than 50% by 2050 (and demand for animal products by 70%). Training farmers can significantly influence behaviour, but delivery methods are equally important. Programs should be tailored to personal factors such as age, and should highlight the value and ease of using technology. Many experts now call for holistic interventions that integrate farmers' social domains, including the use of social media for behavioural change.

While many initiatives have promoted agricultural development, their success has often been localized and difficult to scale. The Green Revolution was an exception due to its limited technological focus and strong government support. Such conditions are unlikely today, making it essential to design context-specific and sustainable interventions.

RECOMMENDATIONS

a) Promote long-term research on farmer behaviour, using control populations where possible.
b) Establish youth resource centres in agriculture to provide smart farming training, guidance, and support.
c) Introduce quotas and targeted programs for women, flexible school calendars, and land lease schemes to involve youth in agriculture.
d) Restructure extension services to improve counselling and information delivery to rural youth.
e) Launch a central-level ICT awareness program for farmers.
f) Engage universities, extension services, and stakeholders in campaigns to involve youth in agricultural policy and value chains.
g) Develop effective monitoring and evaluation mechanisms for youth to express aspirations and contribute to policy-making.

Overall, changing demands in agriculture require the adoption of new technologies. Farmers' hesitation is influenced not only by cost and data concerns but also by personal factors, education, and social norms. Behavioural insights can help identify these influences and guide low-cost interventions to encourage adoption. Although further research is needed on policies and behavioural nudges, current evidence suggests strong potential for improving agricultural practices globally.

REFERENCE

Acharya, S., E. Yoshino, M. Jimba and S. Wakai. 2005. Empowering rural women through a community development approach in Nepal. Community Development Journal, Vol. 42, No. 1 (January 2007). Published by Oxford University Press. https://www.jstor.org/stable/44259024.pp. publication. pp.34-46.

Alenljung, B., 2008. Envisioning a Future Decision Support System for Requirements Engineering: A Holistic and Human-centred Perspective. PhD Thesis, Department of Computer Information Science. Linkoping University, Sweden. https://his.diva-portal.org/smash/record.jsf?pid=diva2%3A174036&dswid=-8618 and https://his.diva-portal.org/smash/get/diva2:174036/FULLTEXT01.pdf

Ajzen I, 2002. Perceived behavioral control, self-efficacy, locus of control, and the theory of planned behavior. J. Appl. Soc. Psychol 32:665–683. https://doi.org/10.1111/j.1559-1816.2002.tb00236.x

Arfan, M. , S. Ali, F. U. khan, G. A. khan, 2013. Comparative analysis of Punjab agriculture helpline and other agricultural information sources for the farmers in district Lahore, J. Agric. Res, 51(4), pp:473-478. https://apply.jar.punjab.gov.pk/upload/1386749724_111_12._4256_Ali_Final_.pdf

The United Nations & Asian Development Bank Institute (ADBI). 2004. Building e-community centres for rural

development. Report of the regional workshop, Dec. 8-14, Bali, Indonesia. Economic and Social Commission for Asia and the pacific Asian Development Bank Institute. United Nations Publication. ISBN: 92-1-120430-5. https://www.adb.org/sites/default/files/publication/159382/adbi-building-ecommunity.pdf

Asrat, Sinafikeh & Yesuf, Mahmud & Carlsson, Fredrik & Wale, Edilegnaw, 2010. "Farmers' preferences for crop variety traits: Lessons for on-farm conservation and technology adoption," Ecological Economics, Elsevier, vol. 69(12): 2394-2401, October. https://ideas.repec.org/a/eee/ecolec/v69y2010i12p2394-2401.html

Awuor, F., Raburu, G., Onditi, A. & Rambim, D., 2016: Building E-Agriculture Framework in Kenya. Journal of Agricultural Informatics, 7(1), pp. 75-93. DOI: 10.17700/jai.2016.7.1.244. http://real.mtak.hu/39155/1/244_1163_1_PB_u.pdf

Bandura A, 2000. Self-efficacy: the foundation of agency. In: J. W. Perrig and A. Grob (Eds.), Control of Human Behavior, Mental Processes, and Consciousness: Essays in honor of the 60th birthday of August Flammer., Lawrence Erlbaum Associates Publishers. pp. 17–33. https://www.taylorfrancis.com/chapters/mono/10.4324/9781410605412-8/self-efficacy-foundation-agency-albert-bandura-walter-perrig-alexander-grob

Butt, M. T, Q., Y.H.Z Muhammad, L. Muhammad, Khan, M., Tian, X., Mehmood, K., 2017. An Exploration of Information Communication Technology (ICTS) In Agricultural Development: The Experiences of Rural Punjab. Transylvanian Review. XXV. 1-9. https://www.researchgate.net/publication/320100053_An_Exploration_of_Information_Communication_Technology_ICTS_In_Agricultural_Development_The_Experiences_of_Rural_Punjab

Chahal S.S., Sidhu M.S. and Parminder K., 2012. Impact assessment of Reuters Market Light (RML) in agricultural information dissemination in Punjab. Agricultural Economics Research Review, 25 (Conference Number 2012): pp.373-378. https://www.indianjournals.com/ijor.aspx?target=ijor:aerr&volume=25&issue=conf&article=002

Chavali1, K., and M. P. Mohanraj, 2016. Impact of Demographic Variables and Risk Tolerance on Investment Decisions: An Empirical Analysis. International Journal of Economics and Financial Issues, 2016, 6(1), 169-175. https://www.econjournals.com/index.php/ijefi/article/view/1571

Davis R, Campell R, Hildon Z, Hobbs L, Michie S, 2015. Theories of behaviour and behaviour change across the social and behavioural sciences: a scoping review. Health Psychol Rev 9:323–344. https://doi.org/10.1080/17437199.2014.941722

Ferroni, M., & Zhou, Y. (2012). Achievements and Challenges in Agricultural Extension in India. Global Journal of Emerging Market Economies, 4(3), 319–346. https://doi.org/10.1177/0974910112460435. https://journals.sagepub.com/doi/abs/10.1177/0974910112460435#tab-contributors

Ganeshagouda, I.P., Parmod Kumar, Manjunatha A.V., Somanagouda I. Patil, Vijayachandra Reddy S., Ramasundaram P. 2013. Impact of KSAMBS' free SMS to farmers on Agricultural Marketing prices- a case study in Karnataka (India). Science Discovery, 1(3): pp.28-34. https://www.sciencepublishinggroup.com/journal/paperinfo.aspx?journalid=182&doi=10.11648/j.sd.20130103.12

Govt. of Pakistan. 2023. Pakistan Economic Survey, Economic Advisor's Wing Finance Division Islamabad. https://www.finance.gov.pk/survey/chapters_23/02_Agriculture.pdf

Jamwal, S., Devanand P., 2011. A case of ICT in Agriculture and Rural Development in J&K. Research cell: an international journal of engineering science. Vol.4: pp.114-122. https://www.i-scholar.in/index.php/RCIJES/article/view/140297

Jena LK, Behera B. 2017. Environmental crisis and human well-being: a review. Int J Dev Sci 6:561–574

Kaur, Simrit and Jha, Samir and Mandal, Rajesh, Information, Efficiency, and Sustainability in Indian Agricultural Markets: E-Choupal, ITC's Private Initiative (September 11, 2014). Available at SSRN: https://ssrn.com/abstract=2526061

Leeuwis C, Schut M, Waters-Bayer A, Mur R, Atta-Krah K and Douthwaite B. 2014. Capacity to innovate from a system CGIAR research program perspective. Penang, Malaysia: CGIAR Research Program on Aquatic Agricultural Systems. Program Brief: AAS-2014-29. http://pubs.iclarm.net/resource_centre/AAS-2014-29.pdf

Lichtenstein, S. & Slovic, Paul. (2006). The construction of preference: An overview Book. The Construction of Preference. Published online by Cambridge

University Press: pp: 1-40. https://www.cambridge.org/core/books/abs/construction-of-preference/construction-of-preference-an-overview/C74C08AB99538A8E234AFEAC23D9B428

Mittal, S., and M., Mamta. 2012. How mobile phones contribute to growth of small India. Quarterly Journal of International Agriculture 51(3): pp.227-244. https://ageconsearch.umn.edu/record/155478?ln=en

Mukherjee, S. 2011. Application of ICT in Rural Development: Opportunities and Challenges. Global Media Journal- Indian Edition/ISSN 2249-5835. Winter Issue 2(2): pp.1-8. https://www.caluniv.ac.in/global-mdia-journal/Winter%20Issue%20December%202011%20Students'%20Research/SR1%20-%20Mukheree.pdf

Nwachukwu, I.N., R.O. Mejeha, and E. Kalu. 2011. Analysis of Managerial efficiency among Agribusiness firms in Abia State, Nigeria. International Journal of Social Science and Humanity. 1(3), pp: 167-170. http://www.ijssh.org/papers/29-H004.pdf

Oyeyinka, R. & Bello, R.. (2013). Farmers Use of ICTS for Marketing Information Outlets in Oyo State, Nigeria. Journal of Agricultural Science. 5. 10.5539/jas.v5n11p150. https://www.ccsenet.org/journal/index.php/jas/article/view/31275

Pickernell, D.G., Christie, M.J., Rowe, P.A., Thomas, B.C., Putterill, L.G. and Lynn Griffiths, J. (2004). Farmers' markets in Wales: making the 'Net work? British Food Journal, Vol. 106 No. 3, pp. 194-210. https://doi.org/10.1108/00070700410528781

Rogers EM (1995). Diffusion of Innovations. 4th edition-Book. The Free Press, New York. https://www.amazon.com/Diffusion-Innovations-Fourth-Everett-Rogers/dp/0029266718

Steg L, Vlek C., 2009. Encouraging pro-environmental behaviour: an integrative review and research agenda. J Environ Psychol 29:309–317. https://doi.org/10.1016/j.jenvp.2008.10.004

Syiem, R. & Raj, S., 2015: Access and Usage of ICTs for Agriculture and Rural Development by the tribal farmers in Meghalaya State of North-East India. Journal of Agricultural Informatics (ISSN 2061-862X), Vol. 6, No. 3, pp. 24-41. http://real.mtak.hu/29903/1/190_1024_1_PB_u.pdf

Tanko, L., O.B. Adeniji and H. Nwachukwu. 2013. Evaluation of the access to and utilization of information communication technology (ICT) facilities among extension officers in Shiroro LGA, Niger State, Nigeria. Journal of Agricultural Extension and Rural Development, 5(1): pp.8-13 https://www.academia.edu/64932551/Evaluation_of_the_access_to_and_utilization_of_information_communication_technology_ICT_facilities_among_extension_officers_in_Shiroro_LGA_Niger_State_Nigeria

Thanuskodi, S. 2010. Use of internet and electronic resources for agricultural science information: a case study, Social Sciences, 5(4): pp.364-367. https://medwelljournals.com/abstract/?doi=sscience.2010.364.367

Tucker, J. S., Wenzel, S. L., Straus, J. B., Ryan, G. W., & Golinelli, D. (2005). Experiencing Interpersonal Violence: Perspectives of Sexually Active, Substance-Using Women Living in Shelters and Low-Income Housing. *Violence Against Women, 11*(10), 1319–1340. https://doi.org/10.1177/1077801205280190

Wolfert, S., L. Ge, C. Verdouw, M. J. Bogaardt. 2017. Big Data in Smart Farming – A review. Agricultural Systems. 153. PP 69-80. https://www.sciencedirect.com/science/article/pii/S0308521X16303754

Zhaoyu Zhai, Jose Fernan Martinez, Victoria Beltran, Nestor Lucas Martinez, 2020. Decision support systems for Agriculture 4.0: Survey and Challenges. Computer and Electronics 170, pp: 1-16. https://www.sciencedirect.com/science/article/pii/S0168169919316497 .