

IMPACT OF SOCIO-PSYCHOLOGICAL FACTORS ON (PRODUCTIVITY BY LAND AND THE LAND MANAGEMENT PRACTICES) INFLUENCES IN ARID AREAS

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ABSTRACT

The major challenges Pakistan faces in the 21st century are agriculture production and food insecurity. The less availability of water can hamper crop production which in turn can give rise to the issue of food insecurity. Pakistan is one of the world's most arid countries with 250mm of precipitation yearly, utilizing almost 94% of water in agriculture. Pakistan is not utilizing its resources efficiently through the modern means of irrigation. Climate change has brought a huge change in the form of risks and vulnerabilities in arid and semi-arid areas. The arid and semi-arid regions are known for their aggressive environmental conditions that usually comprise little unpredictable rainfalls, soaring wind velocity, soaring prospective Evapotranspiration, and acute solar emission. The researcher addressed contradictory results in a variety of empirical investigations by using meta-analysis, a method that is frequently utilized in research. By applying a systematic approach, they collected various articles pertinent to the subject of study. To find original papers relevant to the research, the first stage in the meta-analysis procedure was to create a mental map of the metadata. This study used a two-stage technique the following strategy. First, relevant databases had to be gathered; then, references in the body of current literature had to be examined to conclude. The study analyzed socio-psychological factors affecting land productivity. The psychological factors highlighted were the attitude of farmers towards risky situations. It was indicated that farmers make an attitude based on perceived usefulness and easiness regarding certain agricultural practices and that attitude influences productivity. The findings indicated that to promote land management practices various strategies should be designed to improve awareness and build a positive attitude in farmers to promote productivity.

Keywords: Arid and semi-arid Areas, Productivity, Social Factors, Psychological Factors, Meta-Analysis.

INTRODUCTION

The arid and semi-arid regions are known for their aggressive environmental conditions that usually comprise little unpredictable rainfalls, soaring wind velocity, soaring prospective Evapotranspiration, and acute solar emission (Ahmed et al., 2015, & Ahmed et al., 2016). It has been estimated that almost 41% of the earth's surface is covered with arid lands. Also, it has been playing a crucial part by playing a role of serving these lands as home. Almost a third of the world's population or human beings are living on these lands (Ahmed et al., 2018). Climate change has brought a huge change in the form of risks and vulnerabilities in arid and semi-arid areas (Araya et al., 2011).

The major reason behind this climate change is the lower frequency of the adiabatic rise of immense air, and the moisture associated with the ocean (Ashraf, M., & Routray, J. K. 2015). Agriculture in arid

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and semi-arid areas is facing innumerable and intricate challenges. A downswing or reduction has been observed in productivity and natural resources have been degraded (Ahmed et al., 2015). It has been indicated that arid and semi-arid areas are food insecure due to various factors impacting agriculture and production (Başaran et al., 2017). These regions (arid and semi-arid) are facing food insecurity because of the scarcity of water that directly influences the production process (Lovenstein, Berliner & Van, 1991). Restricted and unpredictable precipitation usually ends up in low production and in some cases a complete crop failure (Biswa, A. K. 2013).

In Arid and semi-arid areas, soil degradation is one of the most important issues that affect crop production and increases the likelihood of food insecurity (Boers, T. M., & Ben-Asher, J. 1982). Most of the countries of Sub-Saharan Africa have arid and semi-arid lands and are faced with the issue of land degradation and heavy rainfalls usually linked to climate change (Borlaug, N. E. 2001 & Bos et al., 2005). Existing literature highlighted that land degradation is usually associated with poverty, especially in rural areas of countries that are developing (Deng et al., 2006). Land degradation usually depends on the idea of the natural reasons behind the degradation phenomenon (Boers, T. M., & Ben-Asher, J. 1982).

The most common examples associated with it are those cultivation areas present on slopes that usually are highly susceptible to exposure to bulks of water in the rainy seasons (Ertek et al., & Yilmaz et al., 2014). This usually results in a reduction in the productivity of soil (Golla, B. 2021). The problems affecting farms or production include heavy rainfall and land degradation. These areas usually practice conserving soil and water (Grum et al., 2017). Another important factor to be highlighted is wind erosion.

In arid and semi-arid areas, the common issues associated with wind erosion include high wind speeds, the texture of the soil, and poor herbage (Guno, C. S., & Agaton, C. B. 2022) & (Hillbur, S. 2012). This erosion ends up in the spread of dust particles in the air, affecting the environment and increasing the risks of land deterioration in arid and semi-arid areas. Crop rotation has a significant influence as opposed to wind erosion (Guno, C. S., & Agaton, C. B. 2022). The dire need for a dry land environment is the need for appropriate socio-economic variables (Boers, T. M., & Ben-Asher, J. 1982).

The major challenges Pakistan faces in the 21st century are agriculture production and food insecurity. The less availability of water can hamper crop production which in turn can give rise to the issue of food insecurity (Jabeen et al., 2022 & Jamshidi et al., 2018). Pakistan is one of the world's most arid countries with 250mm of precipitation yearly (Kassie et al., 2013), and utilizes almost 94% of water in agriculture (Khonje et al., 2015). Pakistan is not utilizing its resources efficiently through modern means of irrigation (Koech, R., & Langat, P. 2018). Promoting food insecurity would not be easy unless the water supply is enough (Kumar et al., 2006) & (Li et al., 2019).

The major limiting factor in agricultural production is the shortage of water in arid areas (Li et al., 2000 & Mesfin et al., 2018). Irrigation is one of the methods for food cultivation and almost 40% of agriculture is obtained through irrigated land (Modarres & Silva, 2007). It has been estimated that after 30 years there will be an extreme rise in water usage, and almost 4 billion people of the world's population will be facing scarcity of water by 2030 (Mohamed et al., 2019). Agricultural production has thus become a challenge in arid and semi-arid areas. Such conditions give rise to various conditions such as droughts (Mortimore et al., 2009). According to, the irrigated water that is drained from Dera Gazi Khan is almost 54% (Muzari et al., 2012).

Agriculture dependent on rainwater accounts for 80% of the agricultural land with a contribution of 2/3rd of agricultural production globally (Ng'ang'a et al., 2016). Rain is beneficial as well as it poses risk factors such as excessive rain could result in flood-like situations that would cause disturbance in production. Rain-fed agriculture is an important aspect of the production of food. Population from different areas of the world are dependent on this food (Ng'ang'a et al., 2016 & Niechayev et al., 2019). It has been estimated that Asia and Africa are being faced with yield gaps that are not because of the scarcity of water but because of not utilizing properly, the available water (Niechayev et al., 2019).

Farmers of ancient times were responsible to store and manage water through a variety of skills (World Health Organization, 2003). Water harvesting methods were utilized to cater to water-related issues faced in those arid and semi-arid areas. Those techniques of water harvesting have now become the center of attention (Oweis, T., & Hachum, A. 2009). This method enables farmers to collect, induce,

and store the water for later use (Oweis, T., & Hachum, A. 2009), (World Health Organization, 2003), & (Li et al., 2000). These water strategies have been utilized in the whole world to deal with the issue of water scarcity (Oweis et al., 1997, & Piao et al., 2010).

Certain assumptions were drawn and described next: (1) The monsoon duration ends up in the natural sink if it is not captured at a save point. (2) The water harvesting methodology is effective in dealing with costs. (3) Water harvesting strategies are effective in regions facing water scarcity as water directly influences economic, social, and environmental values. (4) The shortage of water policy is one of the major reasons for less agricultural productivity (Niechayev et al., 2019). Developing countries are having an uplift in population growth (Pyagay et al., 2018, & Qader et al., 2018) as compared to less or underdeveloped countries where rain-dependent agriculture is a reason for survival (Qamar et al., 2018).

Because of unsustainable population growth, it has been anticipated that around 1 billion tons of grain will be needed to supply the world's food needs by 2025 (Rathore et al., 2019). The current research made clear that a decline in irrigation expansion has slowed the development of irrigated areas. Rainwater is the only thing promoting the semi-arid regions, hence the productivity of rainfed systems is not particularly great (Qamar et al., 2018). About 80% of Pakistan, an agricultural nation, is comprised of dry and semi-arid areas (Qamar et al., 2018). With 250mm of precipitation annually, Pakistan is one of the world's most agricultural nations and uses about 94% of its water for farming. Pakistan is not making the most of its resources by adopting irrigation technology today. Risks and vulnerabilities have significantly changed as a result of climate change in arid and semi-arid regions. The climatic conditions in arid and semi-arid areas are notoriously hostile and are often characterized by little dependable rainfall, high wind speeds, high potential evapotranspiration, and acute solar emission. Since 70% of precipitation occurs during those three months, Pakistan is reliant on glacier melt and monsoon rain (Rockstrom et al., 2010).

According to (Schietecatte et al., 2005), agriculture is a source of feed, food, and fiber, and as a result, it plays a significant role in the economies of emerging nations like Pakistan. The climatic conditions in arid and semi-arid areas are notoriously hostile and are often characterized by little dependable rainfall, high wind speeds, high potential evapotranspiration, and acute solar emission. Mountain agriculture is the country of Pakistan's greatest rain-dependent region (Singh et al., 2009). And the researchers' primary concern is the severe water shortage. Due to the high cost and time requirements, irrigation projects could not be used in mountainous terrain (Stanley, T. D. 2001). Researchers are compelled by all of these difficulties to promote rainwater collection as the most practical method to solve these water-related problems.

The available research suggests that investments in technology purchasing behavior should be made to increase productivity (UNEP, U. 2022). By using better farming techniques and a variety of modern technologies, agricultural productivity might be increased (Van & Yapwattanaphun, 2015), (Van et al., 2000), (Waldorf, B., & Byun, p. 2005), & (Wallace, J. S. 2000). This will aid in enhancing food and lowering serious problems in Pakistan, including poverty. The use of technology might contribute to a transformation that would improve people's quality of life and preserve environmental sustainability (Wezel et al., 2014, & Van et al., 2000).

The focus of the current study was on how social and psychological variables influence farmers' methods of land management. It covers the attitudes of the farmers as well as the dangers that come with arid and semi-arid environments, such as floods, droughts, and abrasive environmental conditions including high wind speeds, high potential evapotranspiration, and acute solar emission. By addressing these concerns and providing evidence from the current explanations, the research supports the existing body of literature. In evaluating the social and psychological elements associated with agricultural output in arid and semi-arid regions, this research goes beyond the scope of the literature survey. In deciding, putting these rules into effect, and developing them, the study is perceptive.

MATERIAL AND METHODS

Though meta-analysis is a widely used research approach, it was used by the researcher as a prominent method built upon the foundation of experimental study. This approach struggled with numerous empirical research that produced contradictory results. A methodical approach was taken to compile a variety of publications related to the topic of the meta-analysis. The literature review outlines

several benefits that come with using meta-analysis. Meta-analysis makes it easier to quantitatively assess the data that currently exists, which helps to provide a thorough grasp of the subject being studied. Moreover, it permits the investigation of differences in analysis among the results that have already been obtained, including variables, demographics, sample characteristics, and the techniques that were employed. This enables researchers to evaluate the merits and drawbacks of studies while taking into account particular national contexts.

Selecting the Subjects of Study

Making a mind map of the dataset was the first step towards starting the meta-analysis. Finding original publications relevant to the present topic was the aim. This study used two steps, adhering to the meta-analysis technique. To conclude the data gathered, the first step involved compiling pertinent databases, and the second stage involved looking through references in the body of current research.

The study aimed to highlight socio-psychological factors associated with production or land productivity practices. The studies that provide sufficient data according to the study variables are selected. Furthermore, those papers were excluded that did not have any variable that matches the current topic. At the end of the selection procedure, the researcher opts for 15 papers. The data collected from the papers were based on the years (1981-2010). The estimation was based on final models and published articles. However, researchers utilized the latest references.

Sustainable Agricultural Practices Studied

When agricultural techniques are implemented using local knowledge and skill-based resources, they are referred to as being sustainable. The environment suffers when external input is used less often. Agriculture will be able to provide greater agricultural output the more sustainable it is. A vital component of livestock and agricultural production, sustainable agriculture aids in converting industrial farming techniques into ecologically friendly ones and so increases output^{52 53 54}. The current research identified important land management techniques, which are detailed next:

Table 1. Land Management Practices

Practices	Definition and Explanation of These Land Management Practices
Agroforestry systems	Planting multipurpose trees on private plots, such as forage trees, perennial fruit (apples, oranges), shrubs, moringa trees, silkworm trees, acacia trees, olive and eucalyptus with crops and/or livestock in the same management unit
Crop rotation	Use of different types of crops one after the other, for example, legume crops (beans, chickpea, lentils, or peas) following cereals (wheat, barley, or maize) in the same area in sequential seasons
Compost	Application of organic materials, such as weeds, farm waste, straw/hay leftovers, dry leaves, ash, and food wastes as organic fertilizer to increase yields

*Table 1 represents sustainable land management practices & their definitions*⁴⁶

Defining Socio-Psychological Variables

Table 2 Description of Psychological & Social Factors & its impact on Land Management practices

Variables	Explanation of the Variables
Attitude	The level to which a farmer feels to adopt agricultural practices after understanding and evaluating their positive and negative consequences.
Personal efficacy	The level in which a farmer evaluates own competencies, skills, knowledge, and capabilities whether those help him to successfully perform agricultural practices.
Perceived resource	The extent of perception of a farmer on how necessary economic resources and rural facilities facilitate or impede the adoption of sustainable agricultural practices.
Media influence	The level of influence on a farmer’s behavior and decisions from formal mass media, like television, radio broadcast, mobile phones, newspapers, and magazines.
Technical training	Perception of a farmer on how capacity building schemes, like attending short-term course training, attending on-farm trials or agricultural field days and participating workshop exposure affects his decisions and behaviors.
Extension services	The level of how access to agricultural advisory services, such as agricultural experts and development agents influence a farmer’s decisions and behaviors
Relational capital	Perception level on how reference groups or informal institutions (friends, families, neighbors and endogenous clubs, like <i>Equb</i> and <i>Idir</i>), who are important for the farmer, affect his decision and behavior (also called interpersonal contact = social pressure).
Group membership	A farmer’s feeling on how formal organizations (farmers’ associations, saving and credit associations, resource users’ groups, and cooperative societies) influence his behavior and decisions. This is also sometimes known as group pressure.
Education	The educational level of the household head whether or not he/she can read and write from religious education or formal schools
Labor supply	Household size adjusted to adult labor equivalent to capture age difference. It is computed as adult male or female (15–60 years) is assigned 1; elders either males and females (+60 years) are 0.70; children both boys and girls (less than 15 years) is 0.50.
Farming experience	The number of years that the household head has stayed in farming. This shows accumulated skills and knowledge in farming decisions, innovations and other issues

Table 2 represents social and psychological factors affecting land management practices ⁴⁶

Model Estimation & Explanation

The literature explains how farmers’ decision of technology acceptance and its usage enhance agricultural production and utility ^{48 53}. The farmers who adopt the conventional management method might anticipate greater benefits from doing so than from not adopting it or continuing to use it (U0 I). Consequently, the model is shown as:

$$D_{im} = \begin{cases} 1 & \text{if } D_{im}^* = E(U^m - U^0) = \alpha X_{im}' + \varepsilon_{im} \geq 0 \\ 0 & \text{Otherwise} \end{cases} \quad (1)$$

Farmers' choice to adopt land management implementation is indicated by the latent variable Dim in the equation previously described. Dim signifies the observable variable (m). This is dependent on a set of explanatory factors, such as risk-taking attitudes, capital or investment (Xi'm), capital or investment attitude, and unobservable traits (im). The error words should include mistakes in perception and optimization.

The following is an example of a multivariate equation for land management practices:

$$D_{im}^* = a_i X_{im} + \varepsilon_{im} ; \quad D_{im} = 1(D_{im}^* > 0) \quad \varepsilon \sim MVN(0, \Omega)$$

The asymmetric variance-covariance matrix, the conditional tetrachoric correlation between two different agricultural practices, and the multivariate equation of land management are all included in the equation above. The multivariate equation of land management is followed through a normal distribution (MVN) with zero means and variance normalized to unity.

Rain Gauges & Climate Zones

Baluchistan is one of the most vulnerable regions to climate change. This province has been through droughts and water scarcity⁵⁵. The estimation put forward the notion that global warming will further increase water scarcity in this province^{56 57}. A description is given in the following figure:

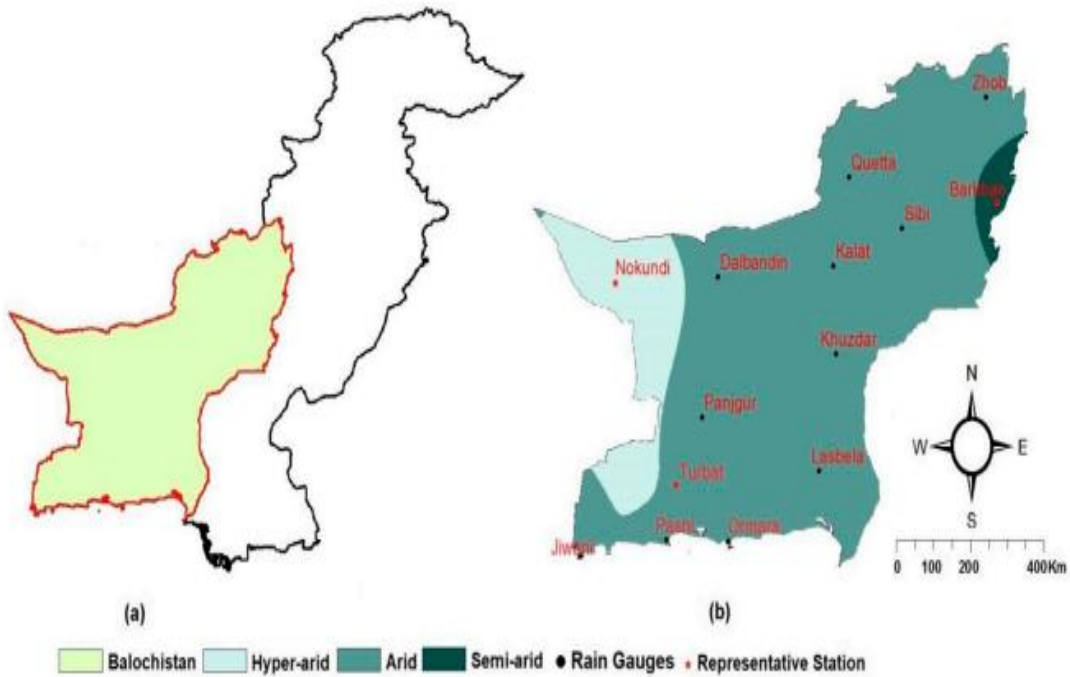


Figure 1. (a) The Balochistan Province in the map of Pakistan. (b) The location of rain gauges in different climatic zones of Balochistan.

Figure 1 demonstrates Baluchistan Province. Source: ⁵⁷

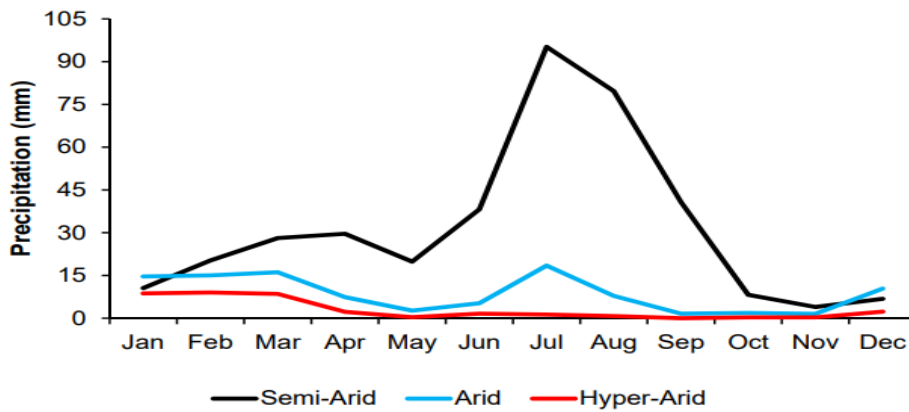


Figure 2. Monthly distribution of precipitation at semi-arid, arid, and hyper-arid regions.

Figure 2 demonstrates the influence on arid, and semi-arid areas in Baluchistan Province. Source: ⁵⁷

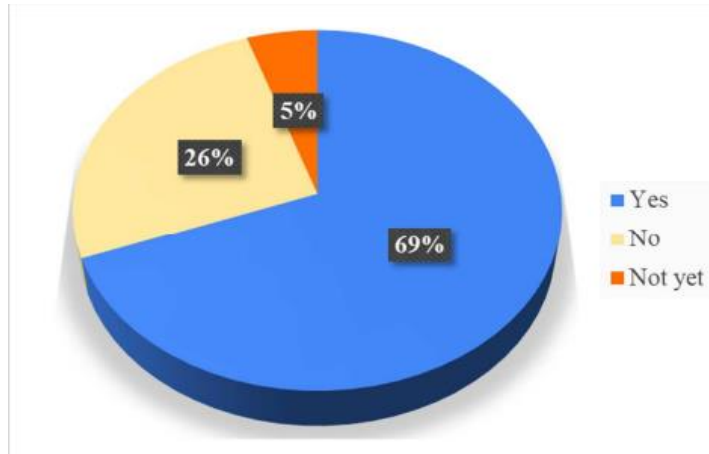


Figure 3 demonstrates the willingness of farmers to purchase solar power systems. Source: ⁵⁸.

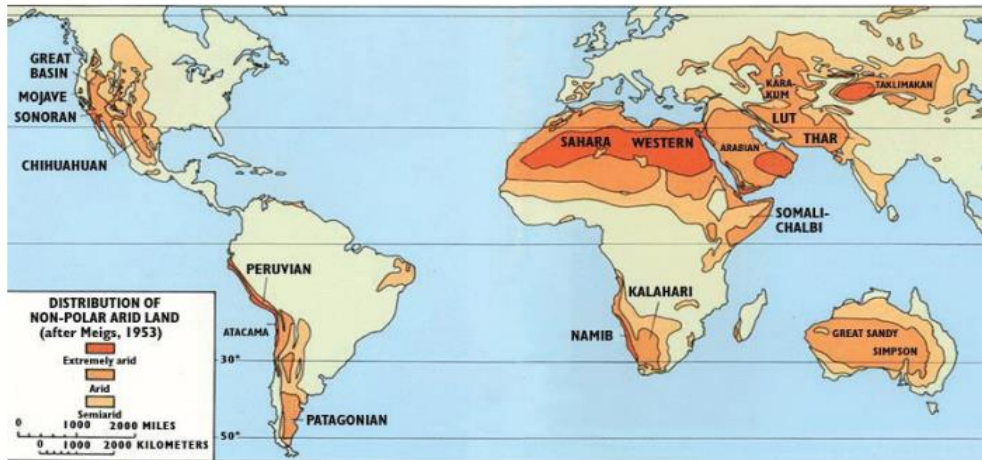


Figure 4 demonstrates arid, and semi-arid areas of the world. Source: ⁵⁹

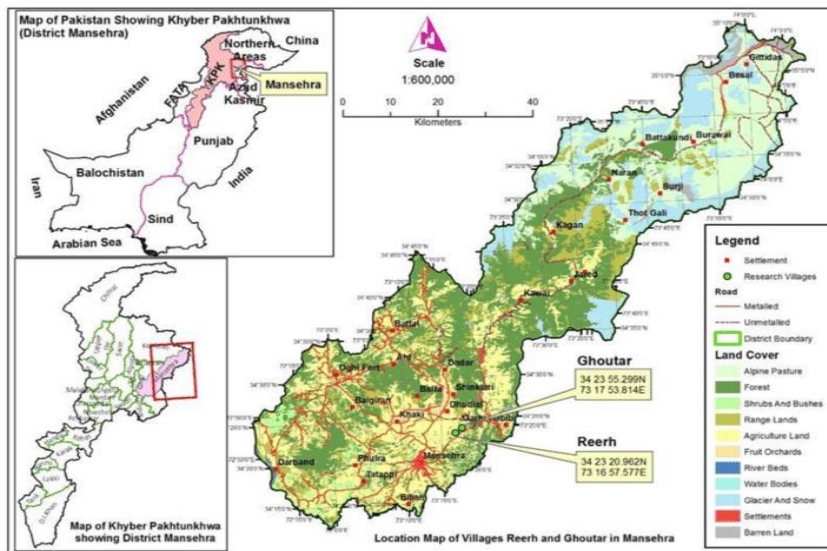


Figure 5 demonstrates arid, and semi-arid areas of KPK Province, Pakistan. Source: ⁵⁹

RESULT AND DISCUSSION

The arid and semi-arid regions are known for the confrontational environmental conditions that usually comprise little unpredictable rainfalls, soaring wind velocity, soaring prospective Evapotranspiration, and acute solar emission. Meta-analysis, is the most widely used study technique, drawing on the traditions of experimental research. The investigation of socio-psychological elements influencing land production was a focus of the study.

Most of the agriculture in the arid and semi-arid areas of the world is faced with multiple constraints including excessive land dryness, water scarcity, temperature rise in the form of warming, and soil-related issues. These issues together are referred to as social factors affecting agricultural production. These issues are difficult to address because of having fewer resources, along with various social and psychological factors. The psychological factors highlighted were the attitude of farmers towards risky situations. It was indicated that farmers make an attitude based on perceived usefulness and easiness regarding certain agricultural practices and that attitude influences productivity. The psychological factors highlighted were comprised of farmers' attitudes toward risky and unforeseen situations. It has also been noted the willingness of farmers to purchase solar power systems was also dependent on the attitude they had regarding the positive influences they gained before it. Existing literature shed light on a clear alliance between agricultural practices and the attitude of farmers. The findings indicated that to promote land management practices various strategies should be designed to improve awareness and build a positive attitude in farmers to promote productivity.

CONCLUSION

The study emphasized the difficult environmental circumstances that are common in arid and semi-arid regions, where there are many obstacles for agriculture to overcome, including a lack of water, problems with the soil, and rising temperatures. Using meta-analysis as the main research method, the study examined socio-psychological elements affecting the productivity of the land in these regions. The study revealed that psychological elements, specifically farmers' perspectives on risk and unanticipated circumstances, significantly influence their farming methods and output. The analysis highlighted how important it is to address these psychological aspects and how attitudes held by farmers—formed based on how easy and effective they believe particular techniques to be—have a big impact on production. Furthermore, it was discovered that farmers' attitudes affected how eager they were to accept advances like solar power systems. The study proposes the application of tactics targeted at raising knowledge and encouraging a positive attitude among farmers as a means of improving land management practices and boosting productivity in arid and semi-arid regions. This emphasizes how crucial it is to address psychological as well as environmental factors when creating successful treatments for sustainable farming methods in these difficult areas.

CONFLICT OF INTEREST

The authors declare no conflicts of interest

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