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REVIEW ARTICLE

Precision Agriculture for Efficient Water use Through Farmers' Cooperatives in Iran

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ABSTRACT

Agriculture is a highly water-consuming activity, and water resources worldwide are heavily exploited for food production. Pollution due to agricultural activities in Iran has increased during the last two decades. Pollutions are released into the atmosphere and thereafter pollute water and soil resources. Agriculture is heavily impacted by present climate change, and the potential reduction of harvest may lead to larger water requirements for sustainable yield and a decline of food security worldwide. This trend is increasing under population growth pressure, and recently increased agricultural land deals that led to transnational water abstraction to sustain food requirements. The concept of virtual water was introduced, that is, the water embodied in the production and trade of agricultural commodities, and assessment of virtual water trade between nations is now a means to quantify the worldwide budget of water resources. A key concept to virtual water quantification is the water footprint, developed for water use assessment in the production of goods, especially food. Water footprint and virtual water trade are used to assess the implications of worldwide trading strategies for food security, also pending climate warming. Nowadays agricultural methods developments that are productively, economically, environmentally, and socially sustainable are required immediately. The concept of precision agriculture is becoming an attractive idea for managing natural resources and realizing modern sustainable agricultural development. Plus pictures of the author's field research visit from a modern and newly established greenhouse complex in Darmian County in south Khorasan province, south east of Iran. In this greenhouse complex utilizing modern technologies for *desalination and suiting it for growing plants and fish farming etc. in this* greenhouse complex planting trees of orange inside the greenhouse – as a byproduct and fancy and amusing tree – and jujube (Ziziphus jujube) and Grape (vinifera) trees and shrubs – as a *windbreaker and* sunshade trees – outside the greenhouse, plus utilizing and selling their products. This greenhouse complex was established by loans and the help of the central government, agricultural bank, and local people in this deprived and remote area with a high degree of salt in its water and soil. In this article, the author discusses and states the most important aspects of precision agriculture for ecological and environmental benefits through farmers' cooperatives for organizing collective action.

Key words: ecological and environmental benefits, farmers' cooperatives, Iran, organizing collective action, precision agriculture, water consuming activity

INTRODUCTION

In the 1960s, sociologists and environmentally minded scholars began to study environmental attitudes. This scholarship flourished in the 1970s as environmental degradation worsened and became a greater concern to the general public in Western societies. Over the past several decades, scholars' theoretical and empirical efforts have been devoted to designing proper measures to gauge pro-environmental attitudes in Western industrialized social contexts (Yu, 2014; P: 39).

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Since low-income communities are more vulnerable to environmental hazards, DeGroot's correlation would suggest more serious environmental concerns among them. Environmental justice scholars, in particular, have focused on this correlation, extending their analyses to environmental inequalities between Black and White communities. Their results indicate a strong correlation on the individual level between environmental suffering and environmental concern (Yu, 2014; P: 41).

Support for environmental protection was most pronounced in countries where there was either a high per capita income or an abundance of environmental problems. people's environmental attitudes in the past 20 years have confirmed that pro-environmental attitudes are more likely to be found among young people, women, the educated, and those most personally affected by environmental degradation (Yu, 2014; P: 42).

Nowadays agricultural methods developments that are productively, economically, environmentally, and socially sustainable are required immediately. The concept of precision agriculture is becoming an attractive idea for managing natural resources and realizing modern sustainable agricultural development (Tohidyan Far and Rezaei-Moghaddam, 2018).

The development policy and conflict literatures highlight the important influence of "high-value" natural resources on sustainable development, conflict, and security at multiple scales. While the physical attributes of these commodities can vary greatly, high-value natural resources generally refer to those commodities that in their natural state have the potential to yield substantial revenues. Classic examples are diamonds, oil, natural gas, gold, uranium, coltan, and several precious gems and minerals. When well-managed, these valuable resources can be the cornerstone of economic prosperity, substantially raising living standards, facilitating socioeconomic equality, and the reduction of state dependence on foreign aid (Douglas and Alie, 2014; P:270).

Today, useful technologies along with strategies of environment conservation as well as viewpoints change from remedial strategies to preventive strategies in using such technologies are at the center of attention. Efforts are made to emphasize applying modern sciences in agriculture that concern production and productivity boost and environmental conservation (Tohidyan Far and Rezaei-Moghaddam, 2018).

There is a real need to analyze the economic benefits and long-term sustainability of future development against the protection of high-class land for current and future production requirements (Curran-Cournane *et al*., 2014).

Securing adequate food supplies for an ever-increasing global population is an emerging international challenge, and healthy soil and water ecosystems are fundamental to ensuring that these needs are achieved. However, the value and importance of soil is often overlooked. Soils are natural capital assets and are a non-renewable resource once lost through irreversible damage and degradation they are effectively lost forever. The global population is projected to reach 8.1 and 9.6 billion by the years 2025 and 2050, respectively, putting immense pressure on our natural resources to meet basic human needs. More than half of the global population currently reside in cities and it is estimated that 60% of the global population will live in urban areas by 2030. High-quality agricultural soils are increasingly under pressure to meet the land demands of these growing cities.

Greenfield developments are large-scale developments, primarily on the city edge, that convert land that has previously been used for rural-based purposes to urban use. The green-field developments dataset includes spatial information for current and proposed developments (Curran-Cournane *et al*., 2014).

In the world's semi-arid regions, high crop demands have produced short-term economic incentives to convert food production on native grasslands to dry land row crop food production, while genetic enhancements and equipment have reduced the risk of crop failure. Until recently, arid and semi-arid grasslands, further from forest margins remained in natural vegetation. However, technology advances have provided the ability to convert these grasslands to row crop production. Semi-arid regions often have high climate variability, vegetation that is dominated by grasses and shrubs, and precipitation/potential evapotranspiration ratios that are >0.2 and <0.5. The semi-arid regions of the United States Great Plains, Sub-Saharan Africa, Australia, and large portions of eastern and southern Africa, India, and Asia provide important habitat for numerous grazing animals, birds, insects, and livestock.

To provide a more sustainable local food supply individuals, communities, corporations, governments, and private foundations are supporting efforts that stimulate economic development in many of the world's semi-arid areas. However, the need for economic development and improved food production must be balanced with agricultural long-term sustainability and the services provided by grasslands (Clay *et al*., 2014).[1-21]

Understanding interactions among the services provided by agricultural systems requires understanding patterns and the individual trade-offs that occur when the delivery of one service is affected by the delivery of another. While it may be straightforward to assess trade-offs between two ecosystem services, it is more difficult to evaluate trade-offs among multiple services. Trade-off curves describe relationships between pairs of sustainability indicators.

Several important ecosystem services are available in row crop agriculture to provide better knowledge for policy and farm-level decision-making. These eight indicators indicate the strength of ecosystem service delivery in our comparative ecosystems.

Agricultural systems can be managed to minimize the environmental impact of agriculture without sacrificing productivity or conversely, to maximize the ecosystem services provided by agriculture, including productivity (Syswerda and Robertson, 2014).

Conservation success is often predicated on local support for conservation which is strongly influenced by Perceptions of the impacts that are experienced by local communities and opinions of management and governance. Beliefs about livelihood and conservation outcomes were intricately linked with perceptions of management and governance. Overall, the perceptions of participants on the quality and effectiveness of management and governance were quite critical (Bennett and Dearden, 2014).

WATER IN IRAN: SITUATIONS AND USERS

Agriculture is the biggest water user in Iran. More than 90% of all water withdrawal is currently used for agricultural purposes. The balance is mainly domestic water, while industry does not play an important role yet. However, the industrial sector will become a more important player in the water sector. Water is an important resource for human society and protection of this natural resource efficiently has become one of the main challenges of this century. According to Iran's geographic information, the country is located in a semi-arid region on the earth. Therefore, it can easily be claimed that the limitation of water resources is one of the major factors in the agricultural development of Iran. The atmospheric precipitation (70% rain and 30% snow) brings the total up to 450 billion m^3 of water. In the present situation, about 269 m^3 of this figure is lost in different forms; however, 30 and 35% of this is devoted to urban areas and agriculture, respectively. On the other hand, 93% of the total water resources are used in the agricultural sector, and <7% is allocated to municipal and industrial uses. Therefore, proper water management in this sector is essential and plays a critical role in the sustainable development of agriculture. Since many countries for years have been faced with a serious crisis due to a shortage of water resources on one hand and the other hand due to population growth and economic and social development, it can be said that water problems in the future will be more and more and water would be undoubtedly an important issue (Samian *et al*., 2015).

Water is a critical resource for farmers, and ensuring access to water is very important for reducing poverty in rural areas because poverty reduction will lead to food security. There is no agriculture and food security without water.

Agricultural water management is a systematic approach to control water in the farm and it leads to the provision of crop irrigation and drainage while there are physical, social, and governmental problems in production systems. The aim of the effective management of agricultural water is to increase economic performance with reduced consumption of water and energy. So, agricultural water management in areas that are facing the problem of water shortage seems to be more important to expect maximum efficiency from the minimum water resources. Undoubtedly, understanding the factors affecting agricultural water management can provide management strategies in agricultural water reusing of waste and additional water, having strict rules against those farmers who waste the water, penalizing unauthorized well users are other variables that can lead to management and optimum use of water (Samian *et al*., 2015).

In an environment with increasing water demand and anticipated negative effects on the water offer due to climate change efficient use of water is getting more and more important. Following an integrated approach water management becomes very complex as it should consider the interests of all stakeholders. Not only environmental, ecological effects of any water management action are important, but economic, social, and cultural impacts need to be considered. However, the strength of the effects varies from region to region. Any management decision has different effects in each region. Therefore integrated water management approach can only be implemented successfully when it follows decentralizing principles. This indicates the need for the establishment of regional, river basin-based institutions that are complementing national entities (Treitler, 2012).

THE CHALLENGES TO ACHIEVING FOOD AND WATER SECURITY

The short- and long-term challenges in the areas of global food and water security are well known. The short-term challenge is nearly 868 million hungry people who need an assured supply of food. Nearly two-thirds of those hungry people are in Asia, a densely populated region of the world that has been driving global growth, trade, and finance since the 1990s. It is also a region where food security has been achieved with increasing reliance on irrigation, with generally positive impacts on food security and poverty reduction. The world's water challenges are just as daunting. The multidimensional nature of food security includes food availability, access, stability, and use. Physical availability is determined by food production, stock levels, and net trade. The economic and physical access of households to food depends on income, expenditures, markets, and prices. Stability is determined by weather conditions, political stability, and economic factors (economic recessions, unemployment, rising food prices). Use is determined by the way the human body makes the most of various nutrients depending on care and feeding practices, food preparation and diversity of the diet, intra-household distribution of food and environmental factors, for example, water and sanitation. Combined with the good biological use of the food consumed, this determines the nutritional status of individuals (Lele *et al*., 2013).

The Global Water Partnership (2012) has defined water security as, "Ensuring the availability of adequate and reliable water resources of acceptable quality, to underpin water service provision for all social and economic activities in a manner that is environmentally sustainable; mitigating water-related risks, such as floods, droughts, and pollution; addressing the conflicts that may arise from disputes over shared waters, especially in situations of growing stress, and turning them into win-win solutions." The incorporation of risks and conflicts is an evolution from the earlier concept of a "water-secure world where there is enough water for household needs, for social and economic development, and for ecosystems". Additional potential for increased production could be found in the world's rain-fed agricultural systems. The low production capacity of these systems at present is evidence of the widespread neglect of investment in agricultural research and extension in rain-fed areas, rather than any inherent deficiency in potential yields (Lele *et al*., 2013).

THE ECONOMIC IMPACT OF AGRICULTURAL POLLUTIONS IN IRAN

Studies on environmental effects caused by agricultural activities in water, soil, and weather sectors have increased in recent years. The growth of agriculture with excessive water consumption in Iran and more use of fertilizers have polluted water resources. The subject of pollution due to agricultural activities in Iran is one of the important challenges of the agricultural sector and has increased in the last two decades. This condition can affect the environment of Iran and cause challenges for sustainable agriculture (Najafi Alamdarlo, 2018) [figure 1].

Undesirable (bad) outputs were produced with desirable (good) products simultaneously, which is often due to the inputs used in the production

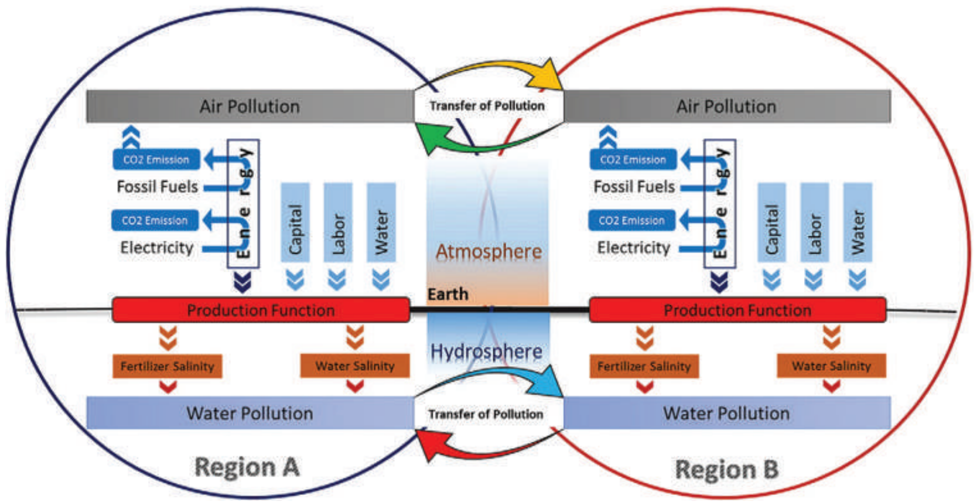

Figure 1: Agricultural pollutions in three dimension (Atmosphere, Hydrosphere and Adjacency regions). (Najafi Alamdarlo, 2018)

process. Therefore, energy consumption in the agricultural sector leads to the emission of CO_2 into the atmosphere Thus, the pollution caused by agriculture is emitted into the atmosphere and transferred to water and soil resources. A certain strategy should be defined for beneficiaries based on the emission of environmental pollution. Furthermore, these pollutions move both on the ground and under the ground leading to the transfer of pollution in adjacent regions. As shown in Figure 1, agricultural activities in region A were produced by using water and other inputs. Using such inputs leads to the emission of pollution on the ground and under the ground. For example, groundwater salinity occurs as a result of water extraction and the use of fertilizers. The created pollution in region A spreads to the adjacent regions. Thus, region B can be polluted as a result of the agricultural activities in another region. Due to the importance of this subject (pollution), models that can analyze such pollutions are needed (Najafi Alamdarlo, 2018) [figure 1].

Many studies have shown that shadow prices are the best instruments for applying environmental control. One way of estimating the undesirable output of shadow price is to use the distance function. Studies on agricultural pollutions are divided into two parts. The first part is comprised of studies conducted to estimate the shadow value of pollutions in the hydrosphere while the second consists of studies that estimated the shadow value of pollutions released in the atmosphere. Here, the target was to obtain a shadow price and use it as an environmental control mechanism. However, in both spheres (atmosphere and hydrosphere), the spatial effects of pollution transfer were disregarded and no study was conducted to estimate the environmental effects caused by the proximity of regions to each other (Najafi Alamdarlo, 2018) [figure 1].

Furthermore, infiltration plays an important role in the hydrologic cycle, runoff generation, soil erosion, as well as irrigation. It has been widely accepted that the hydrologic cycle, runoff generation, soil erosion, and irrigation are effected by infiltration. Precipitation, irrigation, or contaminated spill water, which enters the soil or creates runoff is determined by infiltration. It also plays a key role in controlling crop yield for designing irrigation systems, increasing the efficiency of water and solute transport in the soil profile, and reducing water losses. The amount of infiltrated water into the soil is one of the main parameters for water resources management. The groundwater system sustainability is also dependent on the amount of recharge by infiltrating rainfall (Babaei *et al*., 2018).

FARMER COOPERATIVES (FC) FOR ORGANIZING COLLECTIVE ACTION

In recent years, the concept of an agricultural innovation system (AIS) has gained currency as a way to understand how agricultural innovation takes place, and how innovation can best be supported. An AIS is defined as a system that consists of a wide range of actors from the public, private, and civil sectors to bring new products, new processes, and new forms of organization into economic use, together with the institutions and policies that affect the way different agents interact, share, access and exchange and use knowledge. Although there is much emphasis on knowledge creation, exchange, and use in the above definition of AIS, innovation systems need to fulfill several other functions that are essential for innovation. These functions include fostering entrepreneurial-driven activity, vision development, resource mobilization (e.g. capital), market formation, building legitimacy for change, and overcoming resistance to change by means of advocacy and lobbying. The AIS approach thus recognizes that innovation is a process in which technological developments are combined with new organizational and institutional arrangements, which implies that new forms of coordination within a network of actors are key (Yang *et al*., 2014).

To enhance AIS functioning it is important to stimulate the building of linkages between heterogeneous actors and making their subsequent interactions effective in terms of joint learning, changing practices, and shaping new institutional arrangements, and actors who span boundaries between different actor groups and act as systemic 'innovation intermediaries' have been found essential for this (Golmohammadi, 2018).

An innovation intermediary has been defined as 'an organization or body that acts as an agent or broker in any aspect of the innovation process between two or more parties. Such intermediary activities include: helping to provide information about potential collaborators; brokering a transaction between two or more parties; acting as a mediator, or go-between, for bodies or organizations that are already collaborating; and helping find advice, funding and support for the innovation outcomes of such collaborations.'

Previous research has shown that a wide range of actors from public, private, and civil sectors can take on such innovation intermediary roles, doing brokering both as a core activity (these specialized organizations have been coined 'innovation brokers') and as only one activity within a range of other activities. For example, brokering multilateral linkages in AIS has been coined as a new or additional role for extension services (Yang *et al*., 2014) and (Golmohammadi, 2018).

FC are a more formalized way of organizing collective action of farmers and exist at village, regional, national, and even international levels. They have been found to link different actors and bring synergy to agricultural innovation efforts, combining innovation intermediation with other kinds of services, like input supply and collective marketing. Few researches have taken an innovation intermediary perspective to examine FCs' roles and position in the AIS (Yang *et al*., 2014) and (Golmohammadi, 2018).

Knowledge intermediation is an important part of innovation intermediaries' roles. Knowledge intermediation relates to some functions of classical extension services but also includes broader functions beyond technology dissemination since knowledge is considered to be contextual and co-constructed by stakeholders rather than a fixed "product" transferred from producers to users. Knowledge intermediation is hence about facilitating knowledge co-construction. We identify three functions of intermediaries for effective knowledge production and use: (1) Articulating and voicing the demand of users: articulating needs and demands in terms of technology and relevant knowledge, and voicing the demands to direct innovation support services from research, advisory, and training organizations (matching demand and supply); (2) supplying information for problem-solving and responding to users' needs; (3) engaging and supporting actors (farmers, researchers) in participatory knowledge generation through facilitating demand-led research or articulating experimental/local knowledge. Given that the innovation systems perspective emphasizes the importance of other resources for innovation besides knowledge, innovation intermediaries need to embrace wider functions to bring together all the necessary actors and resources and thus foster conditions for innovation:

1. Building visions on the scope and nature of innovations contemplating new technology, market arrangements, value chain models, etc.: This includes identifying opportunities and constraints, and coupling expectations of different actors;
2. Building and managing networks with actors from different domains: facilitating linkages between potential collaborators as well as other actors that need to be involved because of their enabling or constraining position in the innovation system by means of scanning, scoping, filtering, and matchmaking of actors;

3. Facilitating and participating in learning processes: creating conditions for and participating in learning-by-doing, learning-by-using, learning-by-interacting, and learning-by searching (Yang *et al*., 2014) and (Golmohammadi, 2018).

As innovation intermediaries fulfill liaison positions, and stand between many actors, they gain influence from being accountable to different actors, and they need to balance these accountabilities to be able to create a legitimate position. This balancing of accountabilities is not easy, and innovation intermediaries may face legitimacy tensions as they generally confront diverging and conflicting interests and face accountability conflicts due to multiple demands directed toward them (Golmohammadi, 2018) [Figures 2-76].

PRECISION AGRICULTURE

Innovation is an important factor in the success and survival of knowledge-based organizations. The innovation process is managed for the creation of value, services, products, technology, and new business systems. With the introduction of agricultural informatization, traditional agriculture has been reformed by advanced ICTs, eventually contributing to significant improvements in agricultural productivity and sustainability (Golmohammadi, 2018).

Precision agriculture (PA) is this century's most valuable innovation in farm management that is based on using ICTs. This most recent innovation technology is based on sustainable agriculture and healthy food production, and it follows three principles: Profitability and increasing production, economic efficiency, and the reduction of side effects on the environment. PA is such a new emerging and highly promising technology, that it is spreading rapidly in developed countries. PA research started in the US, Canada, Australia, and Western Europe in the mid-to-late 1980s. Although a considerable research effort has been expended, it is still only a portion of farmers who have practiced any type of PA technologies. PA is conceptualized by a system approach to re-organize the total system of agriculture towards a low-input, high-efficiency, and sustainable agriculture (Allahyari *et al*., 2016).

Agriculture is heavily impacted by present climate change, and the potential reduction of harvest may lead to larger water requirements for sustainable yield and a decline of food security worldwide. Agriculture is a highly water-consuming activity, and water resources worldwide are heavily exploited for food production. This trend is increasing under population growth pressure, and recently increased agricultural land deals that led to transnational water abstraction to sustain food requirements. The concept of virtual water was introduced, that is, the water embodied in the production and trade of agricultural commodities, and assessment of virtual water trade between nations is now a means to quantify the worldwide budget of water resources. A key concept to virtual water quantification is the water footprint, developed for water use assessment in the production of goods, especially food. Water footprint and virtual water trade are used to assess the implications of worldwide trading strategies for food security, also pending climate warming (Nana *et al*., 2014).

Precision agriculture is a management strategy that uses information technology to bring data from multiple sources to bear on decisions associated with crop production. It is aimed at diversifying the management of situations and time to achieve maximum utility in various parts of the field; it should be pathological since there is heterogeneity in different parts of the field. Quantifying the impact of changes in crop function plays an important role in precision agriculture because the overtime changes are unstable. Precision agriculture requires advanced technology for its implementation, such as intelligent agricultural machinery, and it is also time-consuming. Primarily, the farmer must accept it as a management system, trust it, and, finally, apply it to achieve full utility. Along with the various attempts to achieve sustainable agriculture in communities, various strategies have been implemented (Allahyari *et al*., 2016).

It is vital that Iran moves toward precision agriculture technologies quickly due to potential capacities and it cannot be actualized unless different agricultural operators are involved. Due to the key role of agricultural experts in innovation adoption by farmers. Although applying such technologies has increased yield and workforce efficiency, it has destroyed many natural resources on which

Figure 2-76: Field research visiting of author from a modern and new established greenhouse complex in in Darmian County in South Khorasan province, south east of Iran. In this greenhouse complex utilizing modern technologies for *desalination and suiting water for growing plants and fish farming etc. In this* greenhouse complex planting trees of orange inside the greenhouse – as a byproduct and fancy and amusing tree – and Jujube (Ziziphus jujube) and Grape (vinifera) trees and shrubs – as *windbreaker and* sunshade trees - outside the greenhouse, plus utilizing, consuming and selling their products. This greenhouse complex established by loans and helps of central government, agricultural bank and local people in this deprived and remote area with high degree of salinity and salt amount in its water and soil (Pictures by author. October 18, 2024)

Figure 2-76: *(Continued)*

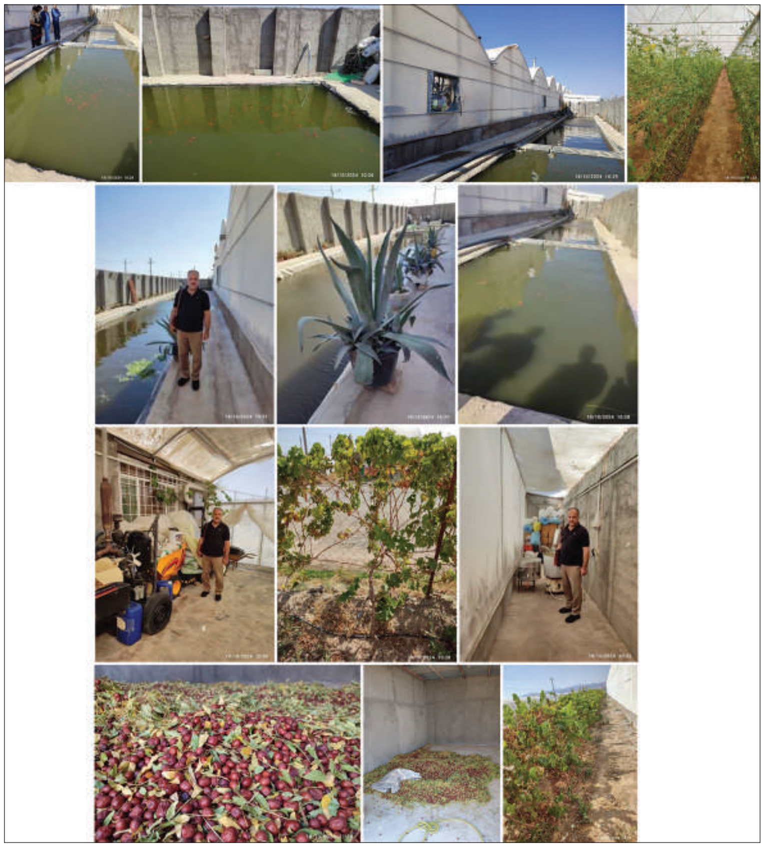

Figure 2-76: *(Continued)*

agricultural systems continuance relies on. Thus, this destruction will first affect farmers and then society. Agricultural products produced through modern agriculture based on green revolution methods bring about many problems for human health and destroy natural resources due to applying improper production patterns, unsustainability of production systems, loss of basic resources, and consequently threaten production facilities, hence this issue makes the production process impossible. Therefore, agricultural methods developments that are productively, economically, and socially sustainable are required immediately.

The concept of precision agriculture, based on information technology, is becoming an attractive idea for managing natural resources and realizing modern sustainable agricultural development. Various researches have been reported that assess the impacts of precision agriculture technologies. This approach can not only decrease costs but can also increase yields. Furthermore, accurately applying chemicals and fertilizers only where needed reduces the potential for ground and surface water pollution. Precision agriculture will not only help cost saving but also have considerable environmental benefits.

People expected the impacts of using precision agriculture in profitability for producers and ecological and environmental profits. Adopting precision agriculture will affect job opportunities (providing consulting services, supporting services, specialized tools, etc.) and agricultural structures, especially farms size distribution in rural areas and using chemical fertilizers, pesticides, and other agricultural inputs efficiently will decrease environmental problems. Precision agriculture technologies resulted in farms' profitability due to an increase of yield and input cost reduction. Meanwhile, financial administration improvement causes risk administration improvement and farm management abilities improvement. Boosting productivity, profitability, and sustainability, improving product quality, efficient product management, preserving soil, water, and energy resources, conserving underground and surface waters, optimizing production efficiency, and minimizing environmental impacts and risks, which is done with the purpose of environmental and economic sustainability are other stipulated impacts of these technologies (Tohidyan Far and Rezaei-Moghaddam, 2018).

CONCLUSION

Different scientists have presented various models to examine attitudes and behaviors (Tohidyan Far and Rezaei-Moghaddam, 2018).

In recent years, agriculture has turned into an industry in response to food provision and food security and human relation with the environment has been changed due to the achievement in different technologies. In this respect, agricultural systems emphasize on utilizing inputs that are produced by fossil fuels, such as chemical fertilizers, pesticides, herbicides, and agricultural machinery with high fuel consumption.

Information technology in agriculture called precision agricultural technologies is considered among modern technologies. This kind of agricultural system is farming precision management based on input data and knowledge and regards using inputs in terms of farm needs and site-specific management. Precision agriculture refers to a systematic approach for remaking the whole system of agriculture for developing sustainable, low-input, and high-yield agriculture. Precision agriculture methods are able to enhance the economic and environmental sustainability of production (Tohidyan Far and Rezaei-Moghaddam, 2018).

The economic activities of local people to respond to their livelihood needs (both cash and subsistence) are causing severe environmental degradation and depletion, especially in developing countries such as Iran. Environmental degradation as a result of large livelihood dependency is a common feature among various Iranian ecosystems (Dehghani Pour, *et al*., 2018).

Food Hygiene and Safety is intended to provide safe and healthy food, from production to consumption, for community members, and prevent complications caused by food additives and industrial materials. The overall goal of Food Safety and Hygiene is to enable the graduates to perform necessary tests, interpret their results, identify food hazards, and implement appropriate methods to prevent food-borne illnesses; the graduates are armed with the knowledge and skills of adopting new effective methods to enhance the quality of food (School of Public Health, 2024).

In response to public concerns, market sensitivity and to reduce the incidence of foodborne disease, especially through the production and consumption of healthy and safe crops, food safety must be considered at any point in the farm-to-fork continuum (Rezaei *et al*., 2018).

There are no comprehensive food composition data on minerals and phytic acid (PA) contents of Iranian foods, which is an important prerequisite when assessing nutrient intake and nutritional status of the population (Roohani *et al*., 2012).

Pollution due to agricultural activities in Iran has increased during the last two decades. Pollutions are released into the atmosphere and thereafter pollute water and soil resources. (Najafi Alamdarlo, 2018).

Livelihood in Iran's rural areas, as elsewhere in the developing world, is highly intertwined with the harvesting of environmental resources, leading to severe environmental degradation. Therefore, interventions aimed at enhancing both conservation and livelihoods should improve the human, social, and financial assets of resource users, to facilitate the adoption of less environmentally reliant and profitable strategies (Dehghani Pour, *et al*., 2018).

As mentioned in the previous sections, understanding local livelihood and its determinants can be the first step in designing more effective environmental conservation programs, especially where local livelihoods are highly dependent on harvesting from environmental resources (Dehghani Pour, *et al*., 2018).

There is a general consensus among policy makers, researchers, and development practitioners that environmental resources particularly forests contribute to rural livelihoods in developing countries by supporting current consumption and providing households with a form of "natural insurance" against hardships. The literature abounds in evidence of forests and other environmental resources' contribution to household income in different regions around the world (Pouliot and Treue, 2013).

Both reductions of greenhouse gas emissions and carbon sequestration have the potential to reduce global climate warming and avoid dangerous climate change (Schimmelpfenniga *et al*., 2014).

Applying precision agriculture systems is regarded as a means of achieving sustainable agriculture, a move towards which is inevitable for all countries, especially developed ones, as a result of environmental problems and food security provisions for a growing population.

Because other agricultural systems such as traditional and organic may not provide the growing population with food security. The most significant social impact of this agricultural system refers to rural areas' development. The most important technical impacts of precision agricultural technologies are the increase of productivity, increasing products quality, and improving farm conditions (Tohidyan Far and Rezaei-Moghaddam, 2018).

Identifying factors that influence the attitudes of agricultural experts regarding precision agriculture plays an important role in developing, promoting, and establishing precision agriculture (Allahyari *et al*., 2016).

According to the results, experts found underground and surface water conservation, rural area development, increase of productivity, and increasing income as the most important impacts of precision agricultural technologies.

Researches must apply theoretical knowledge of precision agriculture in the country of Iran. Approving necessary credits for research and encouraging researchers to plan and apply the relevant plans in precision agriculture are essential too. Perceived usefulness is considered as the most significant variable affecting behavioral attitude and the second-factor influencing the attitude of precision agriculture technologies. Therefore, education should focus on justifying the perceived usefulness of those technologies to experts so that teaching precision agriculture at universities should be regarded more. Planning in-service training courses for experts, forming a network of experts, teachers, and technicians, and developing and performing internship programs for experts are suggested. Finally, officials and relevant policy-makers can establish strategic planning to diffuse these kinds of technologies (Tohidyan Far and Rezaei-Moghaddam, 2018).

The application of precision agriculture (PA) technologies is an alternative to sustainable agriculture. This is one of the fastest-growing alternative agricultural systems in the world. The presence of experts about PA initiates a learning process, enabling potential users to become more aware and confident about PA tools, and thus promoting the perception of an "easy to use" technology. Considering the role of precision agriculture on environmental sustainability and economic efficiency and growth. In other words, the perception and adoption of precision agriculture represent a complex management strategy. Therefore, economic, technical, and accessibility factors should constitute the priority programs of the Agricultural Organization. According to the above considerations, components identified in this study should be recommended by agricultural experts and managers to identify the current situation and improve the required position (Allahyari *et al*., 2016).

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