A SYSTEMATIC APPROACH FOR IDENTIFYING AND PRIORITIZING OF FACTORS INFLUENCING AGRICULTURAL WP

UNE APPROCHE SYSTEMATIQUE POUR IDENTIFIER ET DONNER LA PRIORITE AUX FACTEURS INFLUENÇANT LA PRODUCTIVITE DE L'EAU AGRICOLE (WP)

Nader Heydari[1]

ABSTRACT

Improvement of agricultural water productivity (WP) will help to produce more food with less water i.e., "more crop per drop". For improving WP, firstly the sources of inefficiencies and main factors and parameters leading to the low values of WP should be identified. However, these sources of inefficiencies should be identified for all the water management scales, i.e. plant, field, system, and basin scales and considering socio-economic and policy institution processes governing these physical scales. For the purpose of efficient use of water and enhancing WP, planning of a demand-oriented research, extension, and comprehensive and focused executive activities are required. This could be accomplished through preparation of a strategic planning in this regard. The Strategic Plan for Improving Agricultural WP in Iran was prepared as an initial and important step toward this goal. The main objective of this paper is to develop a holistic and systematic approach and concept for participatory approach towards enhancing agricultural WP in the arid water scarce regions in Iran. It is also based on a modified and a locally adapted concept of the ISNAR approach in this regard. The steps required for the strategic planning of WP are elaborated and some examples and results are provided from the execution of the case of Iran.

Key words: *Agricultural water productivity, Participatory approach, Water use efficiency, Stake holders.*

1 Assistant Professor., Irr. and Drain. Dep., Iranian Agricultural Engineering Research Institute (AERI), P.O.Box 31585-845, Karaj, Iran., Fax: +98-261-2706277, Email: nrheydari@yahoo.com

RESUME

Dans les régions arides, agriculture compte environ 80% de la consommation totale de l'eau. Pourtant en Iran, pays aride et semi-aride, cette valeur atteint 93% de la consommation totale. En Asie occidentale et Afrique du nord, l'eau est devenue rapidement peu abondante, et la concurrence pour l'utilisation de cette ressource devient de plus en plus intensifiée. Dans ces régions, l'eau est le facteur le plus important qui limite la production d'agricole. La majorité des sources conventionnelles d'eau fraîche dans la région ont été développées et des sources d'eau souterraine ont aussi été surexploitées. Par conséquent, ce qui reste en plus du développement de quelques sources non-conventionnelles, est seulement l'effort d'approvisionner la population qui s'accroît en même temps que la disponibilité de l'eau. Autrement dit, il est nécessaire d'augmenter la productivité de l'eau agricole (WP). Pour améliorer la productivité de l'eau agricole, il est nécessaire d'identifier d'abord les sources d'inefficience et les facteurs principaux qui conduisent aux faibles valeurs de la productivité de l'eau agricole. Mais, cela doit se faire à toute échelle de la gestion d'eau, c'est a dire à l'échelle des plantes de champ, du système et du bassin. Au cours de la décennie récente, les problèmes d'eau et de terre sont devenus de plus en plus complexes. Par conséquent, pour la décision et la planification des problèmes de l'eau et de la terre et pour améliorer leurs productivités, il est nécessaire de disposer des informations plus précises et plus complètes. Ainsi, la la productivité de l'eau agricole est un concept plus large. Ainsi sont nombreuses les recherches et les activités pour améliorer cette productivité. Ceci rappelle cette idée que les sujets de recherche et les activités engagées par les instituts de recherche et les organisations exécutives concernées doivent tout d'abord être identifiés et prioritisés parmi les principaux problèmes en vue de la gestion de l'eau et des ressources humaines et financières disponibles et d'autres contraintes. De plus, pour l'objectif d'usage efficace de l'eau, il est nécessaire d'avoir recours aux travaux suivants - amélioration de la productivité de l'eau agricole, planification de demandes orientées vers recherche/extension, préparation d'une stratégie et planification et d'autres activités. Ceci fait partie d'une approche participative avec participation des actionnaires potentiels. Le plan stratégique d'amélioration de la productivité de l'eau agricole en Iran a été préparé à l'origine orienté vers ce but. Principal objectif de cet article est de développer une approche holistique et systématique et le concept pour identification participative et prioritaire des facteurs et des principales sources d'inefficience empêchant la productivité de l'eau agricole dans les régions arides affectées par une pénurie d'eau, compte tenu des résultats et des leçons apprises en cette matière en Asie occidentale et en Afrique du Nord. Cette approche est aussi basée sur un concept modifié et adapté localement selon l'ISNAR dans cette région. Les étapes requises pour planification stratégique de la productivité de l'eau agricole sont élaborées. Des exemples et résultats sont donnés. Selon les résultats obtenus, les étapes suivantes peuvent-être poursuivies pour le développement d'un plan de stratégie pour améliorer la productivité de l'eau agricole: 1) identification des actionnaires potentiels; 2) établissement des groupes de travail, leurs mandats et leurs domaines; 3) étude révisée de situation actuelle de la gestion de l'eau et de la productivité de l'eau agricole; 4) étude révisée des documentations scientifiques publiés 5) conception d'un plan d'action pour résoudre les problèmes liés à l'amélioration de la productivité de l'eau agricole; 6) conception d'un plan d'action pour promouvoir les objectifs d'amélioration de la productivité de l'eau agricole; et 7) donner la priorité aux objectifs d'amélioration de la productivité de l'eau agricole.

Mots clés: *Productivité de l'eau agricole, approche participatoire, efficience d'utilisation de l'eau, responsables.*

1. INTRODUCTION

Public awareness of the scarcity of the water resources has increased considerably over the last 5 to 10 years, as illustrated by the growing number of articles in daily newspapers and weekly magazines. This is certainly true in the western world, but whether this awareness is worldwide is debatable (Kijne et al., 2005). Irrigation currently uses more water than all other users and agriculture faces competing demands for water from other sectors. The solution to water scarcity is most often thought to exist in technological advances, e.g., in the desalination of seawater, and in a reduction of the allocation of water to irrigated agriculture. Many believe that unless properly managed, lack of access to freshwater for agriculture may well emerge as the key constraint to global food production. Others assume that agriculture can produce enough food for a growing population with the same amount of, or even less, water than is used today, if the efficiency and productivity of water use in agriculture, especially irrigated agriculture, increases.

Probably the first use of the term "water use efficiency," to mean the ratio of crop production to evapotranspiration, was by Viets (1966). The term has since become widely used to describe the yield (photosynthesis, biological, or economic) per unit of water (transpiration, evapotranspiration, or applied water). This agronomic view differs from the engineering definition in which water use efficiency means the ratio of the amount of water stored in the root zone to that delivered for irrigation. Irrigation engineers also use the term "irrigation efficiency" to designate the water required to grow a crop (i.e., evapotranspiration, percolation and seepage, leaching for salinity control and land preparation) divided by the water delivered.

Productivity, in general, is a ratio: unit of output per unit of input. Economists refer to total factor productivity as the value of output divided by the value of all inputs. But the concept of partial productivity is widely used by economists and non-economists alike. Depending on how the terms in the numerator and denominator are expressed, water productivity (WP) can be expressed in general physical or economic terms as follows (adopted from Kijne et al., 2005):

- Pure physical productivity is defined as the quantity of the product divided by the amount of water depleted or diverted.
- Combined physical and economic productivity is defined in terms of either the gross or net present value of the crop divided by the amount of water diverted or depleted.
- Economic productivity is the gross or net present value of the product divided by the value of the water diverted or depleted, which can be defined in terms of its value or opportunity cost in the highest alternative use.

In the dry areas, agriculture accounts for about 80% of the total consumption of water (Oweis and Hachum, 2003). However, this accounts even to 93% of the total consumption of water in Iran, as an arid to semi-arid country (Keshavarz et al., 2005). Water is rapidly becoming scarcer in west Asia and North Africa (WANA) and the competition for its use is growing more intense. In these areas, water is the most important factor that limits agricultural production. Most of the conventional sources of fresh water in the region have already been developed and the tendency to overexploit the natural resources, especially more exploitation of border-trans boundary waters, is growing. Therefore, the only option left, in addition to developing some

non-conventional sources, is to feed the ever increasing population of the region using the same amount (or less) of water. Hence the efficiency/productivity of water use in agriculture needs to increase in a sustainable manner. In other word the agricultural production per unit of water used has to be raised.

Agriculture plays an important role in the economy of Iran. It accounts for 18% of the Gross Domestic Product (GDP), 25% of employment, supply of more than 85% of food requirements, 25% of non-petroleum exports, and 90% of raw materials used in various industries (Keshavarz et al., 2003).

The climate of Iran experiences great extremes due to its geographic location and varied topography. Approximately, 90% of the country is arid and semi-arid. The summer is hot with temperatures in the interior reaching as high as 55°C. Water resources management in such extreme environments is a great challenge.

Despite large reliance of the country on agriculture, especially irrigated agriculture, water resources required for agricultural production is very limited. Currently more than 93% of water consumption (84 BCM) is used for irrigating 8.7 million ha. Agriculture, in general and irrigated agriculture in particular, is the largest consumer of water among the country's production sectors; also the major losses of water occur in this sector. With the growing demand for water for industry and domestic uses, combined with environmental concerns, there will be less water for agriculture in the future. Therefore agricultural water productivity (WP) has to be increased.

Based on the latest agricultural statistics, the country produced almost 80 million tons agricultural products from 84 BCM water consumed. Therefore, currently the country's average WP is almost 0.9-1.0 Kg/m^3 which seems quite low in comparison to the world's average value. Based on evaluations, and in order to fulfill the food demand of the growing population of the country with limited available water resources, till year 2025 the value of WP should almost doubled or at least should be located in the range of 1.6-2.0 Kg/m^3. Therefore, a strategic planning is required to reach this important and challenging target.

In the recent decade, due to increasing complexity of the land and water issues, decision making and planning for enhancing the productivity of these two resource bases require more precise, and more comprehensive information. The main challenge is how the scientific information and outputs from research projects can be made useable by the policy makers and executive organizations in their decision makings and plans. Studies have shown that most of the scientific research could not be fully utilized by the policy makers and the soil and water managers. The reasons are: (i) The researchers do not consider, the structure, issues, and limitations that policy makers are facing (ii) The policy makers and executive managers are not oriented towards the research findings (iii) there is considerable time lag between the research development and their reflection in the policies (Maguire, 2007). One of the critics to the research, especially in the developing countries, is that the researches are not relevant or do not fully match with the requirements of the executive organizations. Different reasons are mentioned for this deficiency, e.g., inadequate insight of the research centers to the field realities and to the actual needs of the executive agencies, weak participation and support of the stakeholders and the lack of proper cooperation and transfer of knowledge and research outputs to the stakeholders and executive users.

Results of a national participatory research project on preparing an integrated strategic program for improving agricultural WP in Iran (Heydari et al., 2009), indicated that research institutes and universities in the field of water management are not much oriented to the real problems that executive organizations are facing. Most of the research projects/dissertations are based on research interests of the researchers and students. The research topics normally fall within low priorities in regard to the execution organizations needs. The main emphases of researches are mainly on the technical and hardware issues and in the researches, the integration and innovations are missing. To address this anomaly, relevant research topics and executive activities should be firstly identified and prioritized based on the main problems and necessaries in regard to water management, keeping in view the human and financial resources available and the other limitations. This should be a participatory approach with participation of the stakeholders. The potential stakeholders and actors could be the ministries of energy and agriculture, water board organizations and departments, universities, planning and economics departments, environmental departments, NGOs, scientific associations, consultant engineers, national and international research and scientific institutes and centers, and finally representatives of the farmers and other beneficiaries of the basin.

Improvement of WP will be a big challenge for water scarce and high growing population regions of the world, especially in the regions with poor economy. Many studies and experiences have shown that the past methods of research and extension on water management and WP improvement are no more effective. Recently, it is widely accepted that participatory research, extension, and execution on these issues are necessary and there is big gap in this regard. Enhancement of WP needs an integrated participatory involvement both in the research and the executions aspects. However, sustainable and environmentally sounds participatory approaches for enhancing agricultural WP is a critical issue.

The main objective of this paper is to develop a systematic approach for participatory identification and prioritization of major factors and sources of inefficiencies hindering agricultural WP.

2. METHODOLOGY

The Strategic Plan for improving agricultural WP in Iran was prepared as an initial and important step for the proper orientation and linkage of the research and executive projects on water management and WP improvement. For this purpose representatives of different stakeholders in the water and agriculture sector of the country were gathered and four working groups of the program were constituted namely, Plant, Field, Basin, and Socio-economic-policy-institution. The purpose of theses working groups was to determine the problems and sources of inefficiencies regarding low value of WP in Iran in three scales of water management starting from plant to the field and from field to the system and basin, including the processes and socio-economic and policy-institution issues governing these physical scales.

The methodology of the program was fully participatory. Following identification of the problems, in the form of problem trees, the objectives and research or executive plans for alleviating these problems and reaching the final goal of improving WP, were set in the form of objectives trees and different research and executive action plans. The plan also have linkages with the other strategic plans prepared in the country for the different aspects of

agricultural production and natural resources management e.g.: Drought, Salinity, Greenhouse, Pressurized irrigation, Irrigation networks, Flood, Agricultural mechanization, and different strategic plans for the main crops, e.g., wheat, maize and sugar beet.

This paper attempts to scientifically document the approaches and the processes used to systematically identify and prioritize factors influencing agricultural WP. It is mainly based on experiences, knowledge, and scientific literature, (e.g., Heydari et al., 2009, Heydari, 2009a, Heydari, 2009b, Ashrafi and Heydari, 2009, and Heydari and Abbasi, 2010). The other relevant literature and office work also was done in this regard. In the followings, the steps required for the strategic planning of agricultural WP improvement is provided. It is a modified and a locally adapted concept of the ISNAR approach.

3. RESULTS

In the followings, the systematic approach and steps required for the strategic planning of agricultural WP improvement is provided and elaborated.

3.1. Identification of the potential stakeholders

The potential stakeholders related to the agricultural WP could be the various concerned Ministries and Departments; National Research Institutes dealing with land, water, soil, crop and climate, besides economics; Universities engaged in research, teaching and extension in some or all of the previously mentioned entities; Consultant companies in water, International centers and institutes' regional/local offices; Water users' associations (WUA) representatives, Farmers representatives, NGOs; Water Councils, Individual experts and resource persons of the country, etc.

Required communication and networking with the above mentioned organizations/offices/ institute regarding introducing a qualified representative for the participation in the relevant working groups should be done. Then information of the stakeholder representatives should be stored for future correspondence. Information such as: name, organization, affiliation, work experience, education level, and full contact address of the representatives.

It is important that the nominated representative is experienced, qualified experts/ scientists; motivated and committed to the program, and regularly take part in the working group meetings. Some incentives mechanisms may be useful in this regard.

3.2. Establishment of the working groups and their mandate and realm

Improvement of agricultural WP involves broad and interacting areas such as water, soil, environment, climate, socio-economic, agronomy, management, etc. Therefore it is very difficult to identify some items as the main root of the problems and objectives for enhancing WP. On the other hand based on scientific references, it is also scale/domain dependent. Water productivity is dependent on several factors, including crop genetic material, water management practices, agronomic practices and the economic and policy incentives to produce. Corresponding to this, there are many people working in parallel on means to increase the productivity of water but the effort remains disjointed. Part of the reason is that

we do not have a common conceptual framework for communicating about WP.

Water use and management in agriculture encompass many scales. Working with crops, we think of physiological processes, nutrient uptake and water stress. At a Farm/field scale, processes of interest are different: nutrient application, water conserving practices, bunding of rice-fields, etc. When water is distributed in an irrigation system, important processes include allocation, distribution, conflict resolution and drainage. At the basin scale, allocation and distribution are again important, but to a variety of uses and users of water. At the national and international scales, trade, prices and virtual water all have relevance. Moreover, the Processes between scales are inter-linked. For example, basin-scale allocation practices can set a constraint on how much water a farmer receives and the influence on farm water-management practices. First, we surmise that issues of scale heavily influence concepts of WP. Second, we can differentiate scales of analysis by considering the processes important at each scale. We jump across scales when key processes of consideration change. Thirdly, actions at one scale often influence what happens at a different scale. Fourthly, the definition of WP found useful by people is dependent on the scale of analysis they are working at.

Considering above discussions, title of the working groups actually will form the main branches of the identified problems, i.e., the first layer of the developed problem trees. Selection of the title of the working groups should come and finalized from discussions in a general meeting of stakeholder representatives, which we may call it main committee. However based on the above discussions and experiences, the number and title of working groups which best fits to the scales of water management and WP improvement may be the four working groups namely, Plant/Crop, Farm/Field, Basin/System, and Socio-economic& Policy-institutions (Fig. 1).

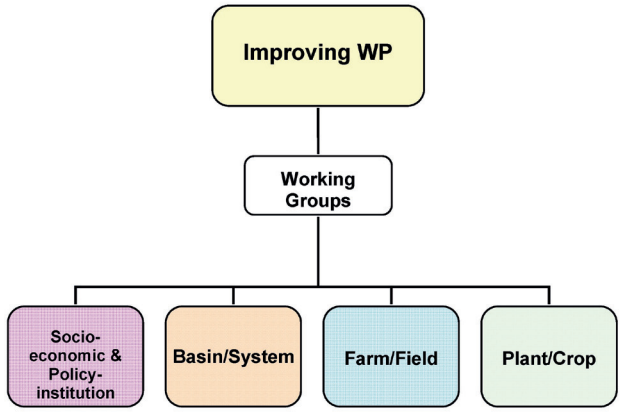

Figure 1. The title of the working groups (adopted from Heydari et al., 2009)(Le titre de groupe du travail (adopté par Heydari, 2009))

The mandate and realm of the working groups potentially could be as follows:

Plant/Crop working group:

Release of crop varieties resistant to different water/yield/climate related stresses, agro-ecology

issues, climate change and its impact on crop, soil and water limitations, biotechnology, crop cultivation and improvement, and extension of research findings to the farmers, etc.

Farm/field working group:

Irrigation efficiency, water for irrigation, soil and water qualities, agricultural mechanization indices, issues on the irrigation systems and irrigation methods, and training and capacity building of the farmers and beneficiaries, etc.

Basin- System working group:

Large scale issues such as water allocation, water conservation, water crisis management, drought management, upstream-downstream basin interactions, water conveyance, trans-basin and transboundary water issues, water balance, demand management, environment, water quality and quantity, irrigation management transfer, participatory irrigation management, cropping pattern, water quality and quantity monitoring, and drain and wastewaters flows, use of recycled and waste water use, and etc.

Socio-economic & Policy institution working group:

Water and WP improvement policies and strategies, Plans for demand and consumption management, legislation, national plans, importance of water and agriculture, water structure, water governance, subsidies, market, trade, export, import, insurance, virtual water, training and capacity programs, and etc.

Provincial/local working groups:

We may have provincial or local working groups. These groups will be useful to collect some local information and issues on the subject. They may provide the following specifically local information as feed back to the main committee and the main four working groups: Agricultural situation and its productivity, sources of inefficiencies in agriculture and water management, local policies and programs to ameliorate the sources of inefficiencies, research projects conducted, and research and extension gaps available.

3.3. A review study of current situation of the water management and agricultural WP in the country

This could include information and analysis on issues e.g.: current values of WP, irrigation efficiencies, the extent of on-farm development activities, the extent of construction or modernization of irrigation projects, issues of modern (pressurized, …) irrigation systems, agricultural productions, cropping patterns, cropping areas, cropping systems, irrigation systems and methods used, soil resources and quality, water resources, water uses and users, irrigated areas, use of treated marginal waters (saline, waste, drain, and desalined waters), rain-fed agriculture and its issues (productivity, management, supplemental irrigation, …), salinity and drainage problems, water and environment, water laws and policies, water prices and pricing regulations, water development projects, water saving targets in the national plans, crop prices and its trend in the past years, future food and water demands trends, drought management issues (impacts, mitigation, and management), and etc.

Preparation of a questionnaire on survey of some local detailed information on status of agriculture and water management of different province/plains of the country is also useful. This questionnaire could be conducted and filled by provincial/local working groups (see section 3.2).

3.4. Review study of scientific literature

This activity should be done following identification of sources of inefficiencies and development of the objective tree. This step is required for the development of the objective trees and prioritization of the objectives for enhancing the WP. Literature review also will help to the elaboration of the problem items mentioned in the problem trees, when these items are explained in narrative manner. In this stage scientific literature related to the problems and issues mentioned in the tree are reviewed from international/national sources e.g., journal papers, conference proceedings papers, books, research reports, internet, and etc.

3.5. Development of the problem tree of enhancing agricultural WP

The problems and sources of inefficiencies leading to low values of WP in different scales should be identified by brain storming discussions in the relevant working groups. The identified problems should be the major and significant problems associated with WP. In figures 2.a to 2.f, problem tree of enhancing agricultural WP in the Karkheh River Basin (KRB) for the Plant scale is presented as sample.

3.6. Development of the objective tree of enhancing agricultural WP

Following development of the problem tree, the objective tree could be developed. The tree comprises of objectives required to eliminate or alleviate the important problems mentioned in the problem tree. In figure 3, the basin scale objective tree of enhancing WP in the KRB is provided as sample.

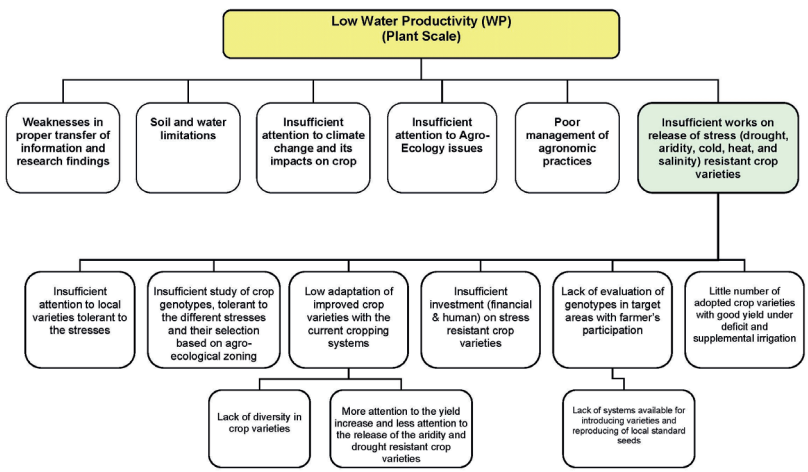

Figure 2.a. Problem tree of improving WP at Plant scale in the KRB Basin (adopted from Heydari, 2010) (Arbre des problèmes de l'amélioration de WP a l'échelle de Plante dans le basin de KRB (adapté par Heydari, 2010)

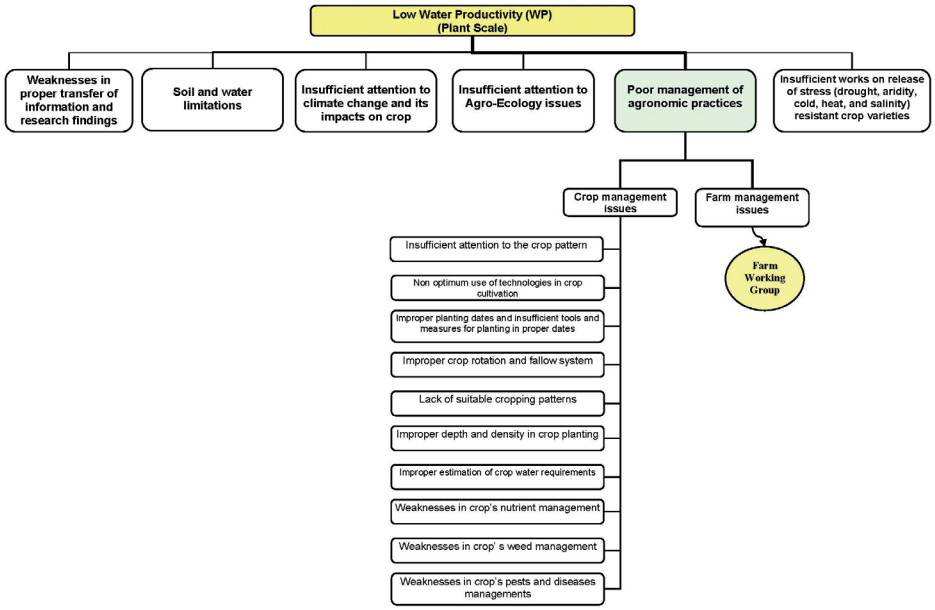

Figure 2.b. Problem tree of improving WP at Plant scale in the KRB Basin (Cont'd) (adopted from Heydari, 2010) (Arbre des problèmes de WP a l'échelle de Plante dans le basin de KRB (continue))

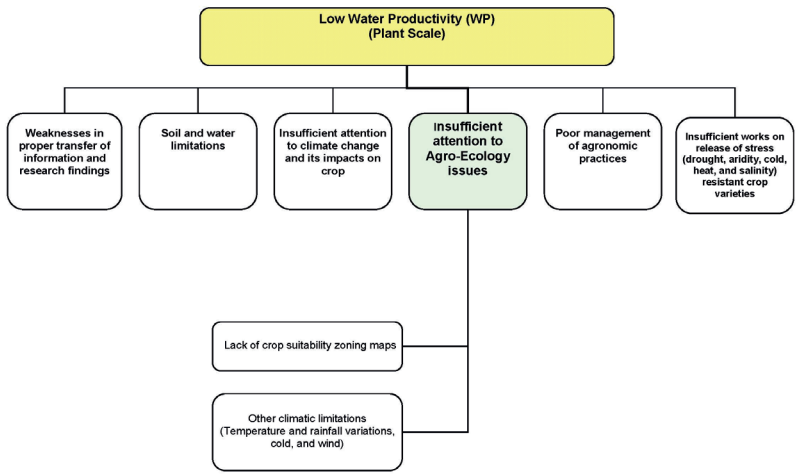

Figure 2.c. Problem tree of improving WP at Plant scale in the KRB Basin (Cont'd) (adopted from Heydari, 2010) (Arbre des problèmes de WP a l'échelle de Plante dans le basin de KRB (continue)

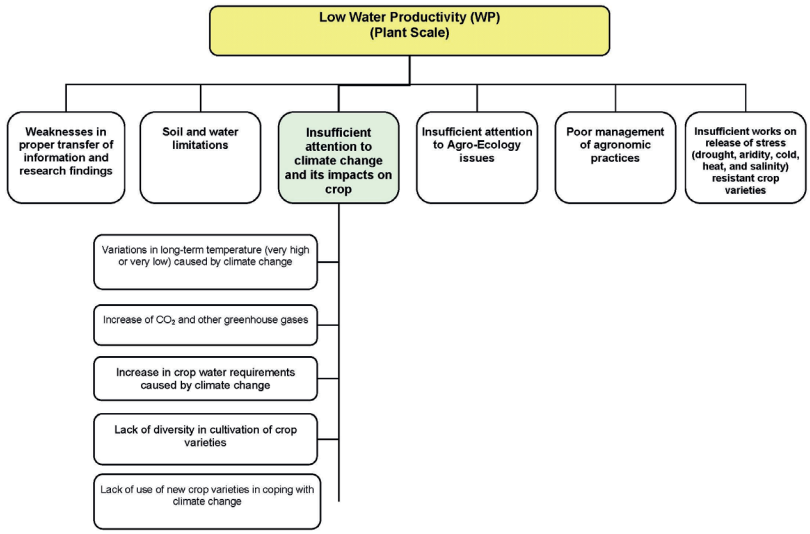

Figure 2.d. Problem tree of improving WP at Plant scale in the KRB Basin (Cont'd) (adopted from Heydari, 2010) (Arbre des problèmes de WP a l'échelle de Plante dans le basin de KRB (continue))

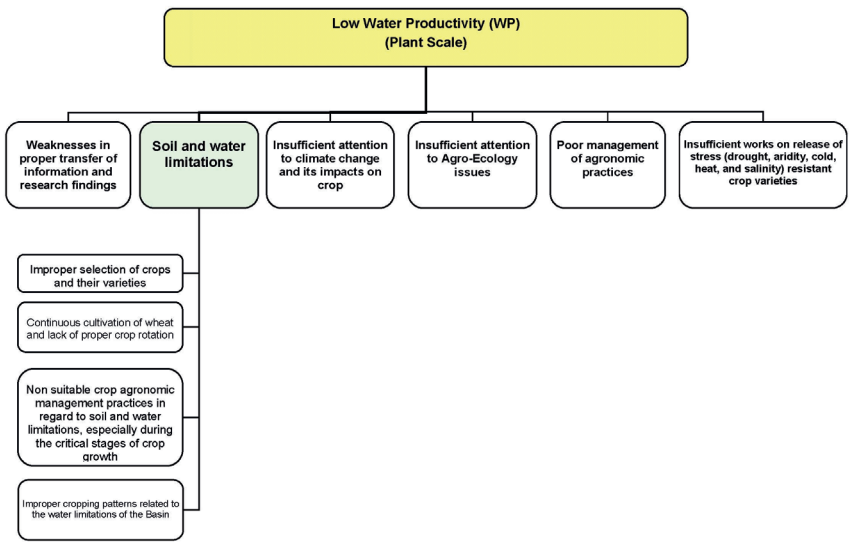

Figure 2.e. Problem tree of improving WP at Plant scale in the KRB Basin (Cont'd) (adopted from Heydari, 2010) (Arbre des problèmes de WP a l'échelle de Plante dans le basin de KRB (continue)

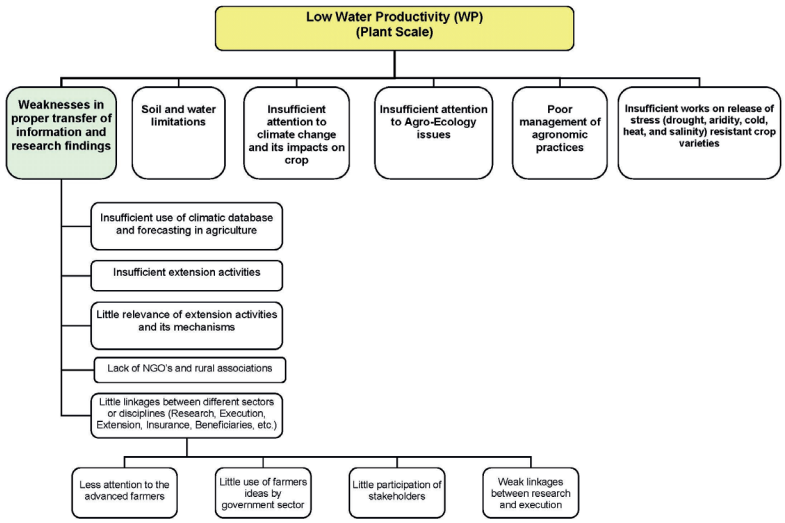

Figure 2.f. Problem tree of improving WP at Plant scale in the KRB Basin (Cont'd) (adopted from Heydari, 2010) (Arbre des problèmes de WP a l'échelle de Plante dans le basin de KRB (continue))

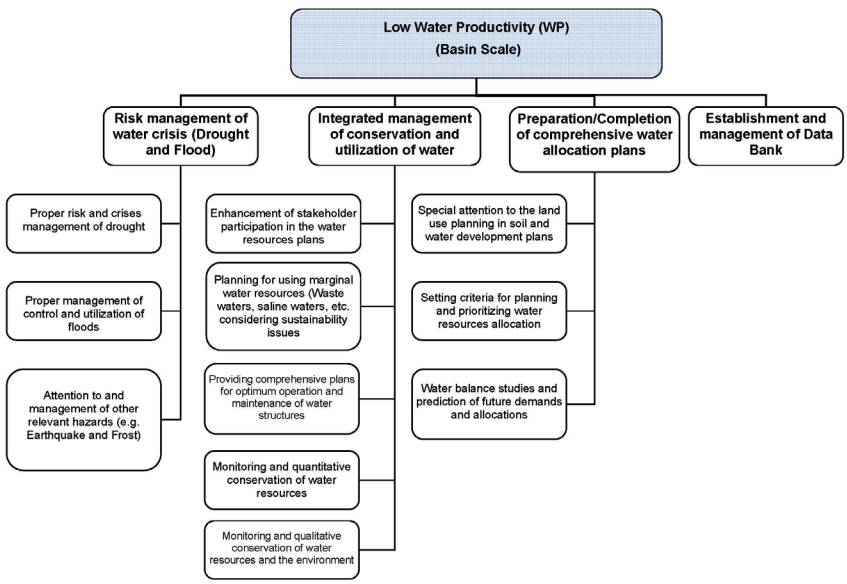

Figure 3. Objective tree (main branches) of improving WP improvement at Basin scale in the KRB Basin (adopted from Heydari, 2010) (Arbre des objectifs (Branche principale) de l'amélioration de productivité de l'eau a l'échelle du Basin dans le basin de KRB)

None of the identified objectives have similar nature, characteristics, and or responsible organization/institution. In other words, some objectives may be inherently in kind of executive

or non-researchable objectives. It is the responsibility of executive organizations/institutions to deal with them. However some of the objectives are researchable type and should be dealt by research institutes. These are the objectives on which, there are not enough literature and research results before their implementation and or going into practice by executive organizations. However some of the objectives may have both executive and researchable characteristics.

Based on consultation and discussions in the working groups, the identified objectives could be categorized into the three mentioned categories and could be indicated by "**E**", "**R**", and "**E&R**" for the executive, researchable, and executive-researchable categories respectively.

For example in the KRB the following basin-scale objectives can be categorized as Executive, Researchable and Executive-Researchable respectively:

- Provision of infrastructure and planning required for the more use of domestic and agricultural waste/drainage waters **(E)**
- Development of drought forecasting models **(R)**
- Drought risk management **(E&R)**

3.7. Prioritization of objectives for enhancing agricultural WP

It is evident that all of the identified objectives have no similar and equal importance and magnificence in improving WP. On the other hand, based on resources (human, financial, technical,¬…) available, it is not possible or logic to deal with these objectives at the same time. Therefore the objectives should be prioritized.

The importance of the objectives can be categorized in the four levels of prioritization as "Very high important", High important", Medium/Moderate important", and "Low important" denoted by "**V**", "**H**", "**M**", and "**L**" signs respectively. This kind of prioritization also should be conducted in the working group discussions in a participatory manner. For example in the KRB basin the following objectives of the Socio-economic& policy-intuition issue could be categorized in the "**V**", "**H**", "**M**", and "**L**" respectively:

- Volumetric allocation of water to the farmers **(V)**
- Provision of measure for purchasing of water saved by the farmers when applying water saving technologies or better water management approaches **(H)**
- Evaluation of crop pricing methods on cropping pattern **(M)**
- Expansion of crop insurance systems **(L)**

Then another prioritization or ranking could be done within the objective listed in the "**V**" or "**H**" groups of prioritized objectives in every scale of WP improvement.
In the followings the ranking (top 5) among the "**V**" group for the different scales of WP improvement in Iran (Heydari et al., 2009) is provided as sample.

Plant scale:

1. Release of crop varieties resistant to the aridity, drought, salinity, and cold stresses
2. Planning and enough investment (financial and human) for release and adoption of stress

resistant crop varieties (mainly Wheat, Barely, and Chickpea)

3. Proper crop rotation, and cropping systems and patterns
4. Enhanced use of climatic data and forecasting
5. Enhancement of extension activities and improvement of its methods in transferring research findings to the farmers

Farm scale:

1. Water pricing
2. More supervision and control on over exploitation of water
3. Implementation of supplemental irrigation techniques in the rain-fed cropping areas
4. Increase of farmer's knowledge and information on soil-water-plant issues
5. Improvement of water application efficiencies in order to save water and prevent soil waterlogging

Basin Scale:

1. Comprehensive study of upstream impacts on basin's downstream
2. Drought risk management
3. Proper water allocation plans in irrigation networks, especially during drought incidences
4. Establishment of basin's database
5. Coordinated organizational activities on monitoring and protection of the basin's water and soil quality and the environment

Socio-economic & Policy Institution:

1. Establishment of the basin council
2. Updating and implementation of the national document on optimum use of water in relation to the crop water requirement
3. Modification/improvement of the inheritance, agricultural land ownership and utilization laws and rules
4. Enhancement of water users associations (WUA) in water management decisions and activities (from supply to use)
5. Implementation of water trade/market systems and mechanisms

The prioritized and ranked objectives could also be categorized and listed again based on executive "**E**", researchable "**R**", and executive-researchable "**E&R**" categories.

The final stage should be setting focal pivot projects (and sub-projects) for achieving the objective of WP improvement. These projects should be originated and determined from the objectives with high priorities (V and H categories). It is evident that these projects could also be categorized and listed based on the "**E**", "**R**", and "**E&R**" topics again.

4. CONCLUSIONS

Water scarcity is the most limiting factor in agricultural production of Iran. Improvement of WP is one the important necessities of the water scarce countries having growing population and growing demand of water for food production, e.g. Iran. This will lead to the surplus of water and agricultural crops and commodities in the region and will help to more virtual water trade among the countries in the region and more allocation of water to the downstream and ecosystems.

Attentions to water supply and improvement in WP programs have been one of the most important and governing policies during the past 25 years. In this regard different rules are set and in addition, different technical and infrastructures activities (executive, research, and consultation), in both public and private sectors are developed. This attention, in addition to establishment of special laws and regulations, has been considered in the instruction of development programs.

However improvement of WP involves different soil and water issues and different disciplines. Therefore it needs strategic planning and setting the identified targets relevant to the different scales and sectors. Without strategic planning, the water related problems and issues will be more in number and also in its complexity, without oriented executive and research activities.

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