International Journal of Agronomy and Agricultural Research (IJAAR)
ISSN: 2223-7054 (Print) 2225-3610 (Online)
http://www.innspub.net
Vol. 5, No. 6, p. 57-63, 2014

INNSPUB

RESEARCH PAPER OPEN ACCESS

Opportunities and potential integration of irrigation and aquaculture in morocco

Aba Mustapha[1*], Belghyti Driss[1], ,Berday Nadia[2], Natify wydad[2]

[1] *Biology and Health Laboratory, Environmental and Parasitology Team/UFR doctoral "Parasitology compared: Medical and Veterinary Applications," Sciences Faculty, Ibn Tofail University, Morocco*

[2] *Agronomic and Veterinary Institute, Hassan II, Rabat, Morocco*

Article published on December 18, 2014

Key words: Aquaculture, Irrigation, Fish, Morocco, Potentialities.

Abstract

A key challenge facing agriculture in the 21st century is how to feed a world with a continuously growing and increasingly affluent population with greater meat demand. Sustainability of food production increasingly require the use of sound and efficient practices in the use of water, in particular the development and management of irrigation. Food security is a high priority in the world; Agriculture must not only feed populations growing membership, but also save water for other purposes. Water will become the main limiting factor for much of the planet over the next century. This resource will be more critical in areas under water stress such as Morocco. Aquatic resources are limited's, the search for new marins fish sources is constant. In Morocco, irrigation systems cover very large areas and permanent increase. However, the ability to use water for irrigation ponds as fish stocks has never been used for fish production. The challenge is to develop and apply techniques and methods of water management by integrating aquaculture with irrigation. Faced with the growing problem of mobilizing the "water" resource, Many studies are conducted to determine ways to make water savings by optimizing the use or the development of new sources of supply. In this context, reuse of aquaculture waters can be considered one of the solutions for new sources of irrigation water. This technique will help increase the efficiency and productivity of water use by plants on discarding fish which will enable improved agricultural productivity without resorting to the use of fertilizers.

* **Corresponding Author:** Aba Mustapha ✉ aba.mustapha@gmail.com

Introduction

The trend of agricultural productivity growth in the last decade has been tremendous in many ways, which helped to alleviate food insecurity in Morocco. Nonetheless, climate change threatens to exacerbate the existing challenges faced by agriculture. The global population is estimated to reach 9 billion by 2050, with the bulk of the increase occurring mostly in Africa and South Asia. Also, taking into account the accelerated demand for food and changes in dietary habits, the FAO estimated that feeding world population will require a 70 percent increase in total agricultural production (FAO, 2010).

Agriculture uses 70% of the fresh water available for human use, making them largest user of water (United Nations, 2006).This water resource not only maintains the crop production level but also helps in poverty alleviation of crop and non-crop producing farmers'. Water for agriculture is critical for future global food security. Once assumed unlimited in supply, now even in developed countries water is considered scarce. Further, it is believed that climate change will increase water scarcity in the coming decades (Lobell *et al*., 2008).Water for agriculture is critical to the future of global food security because it uses more than 70% of total water resources. However, the continued increase in demand for water by non-agricultural uses, such as urban and industrial uses, and greater concern for environmental quality have put the demand for irrigation water in a closer examination and threatened food security. Water scarcity is already a major concern in some parts of the world (Fedoroff *et al*., 2010). Food and nutritional security has been worsened in many countries, and Population growth has exceeded the agricultural growth rate. To feed all, current agricultural production needs to be at least doubled while adapting to climate change without harming biodiversity, environment and water resources (Gurung, 2012). Agriculture is the main aspiration to built strong base for economic growth for many countries, especially Morocco

This summary focuses on the opportunities offered by the irrigation ponds for fish production. Fish contributes significantly to the overall production of animal protein, especially in developing countries, where fish proteins account for 70 percent of dietary protein. Aquatic resources are limited (FAO, 2014), the search for new marine fish sources is constant. Irrigation systems cover areas increasingly significant and permanent increase in Morocco, however, the possibility of using storage basins for irrigation water as fisheries resources has never been exploited in Morocco, by integrating aquaculture irrigation.

No studies have been conducted in Morocco, about the integration of aquaculture in irrigation in the water storage tanks. In this context the study will focus on the importance of this new technology feasible in Morocco. The purpose of this paper is to gather all relevant information and provide an overview of some of the method used for fish production in irrigation basins water.

Moroccan Agriculture

Agriculture is a key sector of the Moroccan economy, playing crucial social and economic roles. Moroccan economy is still relying importantly on agricultural sector. This latter contribute by 15 to 22% to the total value added. Furthermore, it employs about 40% of the total employment and 80% of the rural labour force (Bentour, 2014).

Adopted in 2008, the Green Morocco Plan provides a more strategic sector in Morocco, namely agriculture. The sector currently employs some 4 million people in rural areas. Agriculture in Morocco plays a key role in macro-economic balance of the country through a stake of up to 19% of gross domestic product GDP. And that's not all, agriculture supports a significant social burden, since it is the income of more than 80% of the 14 million rural Moroccans.(MADRPM, 2008) The importance of this sector has been boosted by setting, in addition to Morocco green strategy, a strategy with a vision that spans 12 years, from 2008 to 2020 objectives are already fixed private investment reach 110 to 150 billion DH in activities

with high added value, 2.5 times the sector's contribution to GDP and create 1.5 million jobs (MADRPM,2008) .

The performance of the agricultural sector is highly dependent on climatic conditions, the country suffers from a cruel paradox in the form of advantageous precipitation patterns in the northern regions, but with very poor soil quality, and vice-versa in the southern regions (Akesbi, 2006).

But agriculture is closely linked to water, in this context, the new Green Morocco Plan (GMP) was developed in order to make the agricultural sector the main engine of economic growth and national development during the next 10 to 15 years. The water situation has been particularly analysed in light of the new strategy because of its scarcity and its vulnerability to climate change (Boughlala, 2013).So, Morocco needs to promote a "blue revolution" in order to achieve in better conditions the Green Morocco Plan presented by "green economy".

Irrigation systems

Morocco is one of the countries most threatened by climate change. These changes will have a negative impact on key sectors of its national economy, namely water and agriculture. Projections predict that the water available for agriculture will decrease by 16 per cent by 2030 and 34 per cent by 2050. The main strategy for adaptation to this change is the conversion from surface irrigation to drip irrigation.(Boughlala, 2013)

Water management in Morocco, must satisfy the needs of its three major users: agriculture, industry, and the household sector. Reduction of rural socioeconomic deficiencies is directly related to sustainable water management, whether for irrigation (Laamari, 2014).

The gravity irrigation accounts for about 80% of the area of large irrigated perimeters of Morocco, therefore water loss remain significant. It is therefore necessary to reduce these losses by using proper irrigation techniques. This is especially true, as the demand for irrigation water will be more important in the years to come.

Water is at the heart of the reforms of the Green Morocco Plan. It is in this context that the introduction of a new irrigation technique: the Drip.

The Moroccan government has paid great importance to the expansion of space equipped with drip irrigation techniques Resulted in a policy of voluntary regime Morocco Green in the national program for water saving irrigation Which aims to transform the nearly 550,000 hectares of irrigated land to drip irrigation In 2020. In Morocco, it is the available water resources much more than the land suitable for irrigation which limit irrigation potential (Debbagh *et al.*, 2002).

Drip irrigation involves ensuring regular water supply. The project adopted the storage basin of water as an interface between the water supply and regular needs of irrigators. (FAO, 2012a, Doukkala).

The National Irrigation Water Economics Program (PNEEI) whose purpose is to protect water resources against the impacts of climate change and improve the living conditions of rural populations through sustainable management of water resources. This conversion to drip irrigation will encourage farmers to use storage ponds of water whose number will increase over time due to agricultural areas which will be irrigated.

Moroccan Aquaculture

Fish farming in its current state in Morocco, is dominated by a modern operating very often structured. In this area with great potential for development, Morocco is endowed with several fish hatcheries refurbished where high fish species of fresh and brackish waters belonging to six families(Aba *et al.*, 2014). The nine species currently cultured in Morocco, belong to six major families of cold water and hot water; Cyprinidae, Salmonidae-Esocidae, the Centrarchidae, cichlids and Anguilidés

.(Aba *et al.*, 2014), that are either endemic or non-native fresh or brackish waters.

The amount of poisons intensive aquaculture is modest about 1400 tons (FAO, 2014). The reasons for the poor performance of fish farming sector in our country are manifold; often linked to the absence of national and regional policies to promote fish farming, this can have a direct relationship with the fishery products, where Morocco is recognized by the marine fish production(Aba *et al.*, 2014).

5. Concept of IAI

Integrated Aquaculture with Irrigation (IAI) is not a new concept, it has simply been overlooked by modern agriculture. It has been practice subsistence level in Southeast Asia for centuries. Over the past two decades, international organization such as FAO and UNDP supported IAI at a low level, mainly in order to increase the productivity of subsistence agriculture. But Morocco's case it differs greatly from that of Asia as the integration of aquaculture irrigation is linked to a new technique. This technique relies on the use of storage tanks of water, designed for irrigation.

The productivity of water may be increased through integrated irrigated aquaculture (IIA), the integration of aquaculture in irrigation systems, with aquaculture essentially a non consumptive activity with fish farmed in the water on its way to or from agriculture (FAO, 2006)

Integrated aquaculture with in irrigation in storage tanks for irrigation adds value to stored water in basins of water irrigation and enhances productivity through multiple usage (Behera *et al.*, 2012).

Generally fish culture may be an option for many farmers who have storage ponds of water for irrigation. Therefore, the availability of land suitable for aquaculture, together with prevailing macro- and micro climate, political stability, government policy, fish consumption patterns and fish market integration can affected a country's aquaculture growth and development (Boyd *et al.*, 2012). The Morocco has a geographic variation, climate, political stability and the strength of the state to develop this technique.

In this regard, the use of existing irrigation structures for fish culture wil have much potential. Since aquaculture does not consume water, it will not influence the quantity of the water reserved for irrigation. Many studies around the world have successfully demonstrated the potential of integrating fish production within irrigation systems (Gooley and Gavine 2003; Pollock, 2005; Gurung 2012; Pant *et al.*, 2012). In general, China, Australia , Sri Lanka, Laos, Cambodia, Bangladesh and India are the countries where irrigational water is prioritized to use for aquaculture in integration with crops (Halwart and van Dam 2006). The same technique has been used in Nepal, and gave better results (Gurung, 2012).

In Morocco integrated aquaculture with irrigation, will be considered relatively new compared to agricultural farming practice and exhibit a wide range of potential development of this sector . This new approach in Morocco, will enhance the knowledge on the socio-ecological interaction of aquaculture and historical established agriculture.

Increased food production requires more water. Water is a finite resource and its availability is limited by natural availability through the water cycle. As water becomes an increasingly scarce commodity, water productivity has to increase through diversified farming systems (Behera *et al.*, 2012). Existing methods and networks for water storage and distribution are not used for fish production (Ingram *et al.*, 2000).

Tanks of irrigation have proven to be viable water bodies for selective fish production. The main wastes derived from fish production are fish faeces and uneaten feed and is rich in P and N which have the potential to alter the trophic status of the water (Daou, 2012; Aba *et al.*, 2013).

The use of irrigation water tanks for aquaculture is becoming increasingly common worldwide and provides a system to alleviate the pressure on the demand for primary water usage for food production.

Aquaculture provides an opportunity to contribute towards socio-economic development, insure food security create jobs, through multiple and sustainable utilization of water resources, for rural communities in Morocco . An opportunity has been identified for the integration of aquaculture into existing agricultural development without an increased consumptive demand on water resources, whilst limiting the impact on water quality through best management practices for all users (Salie *et al.*, 1998). At present, with the global emphasis on sustainable development, particularly in the agricultural sector, more effort is being put into optimizing resource of water use rather than exploiting new resources. Due to the nature of the operation of aquaculture systems in storage basins for irrigation water, they allow the discharge of waste such as food scraps, feces, all the soluble organic waste such elements rich in nitrogen and phosphorus and can be used directly by crops(Rana *et al.*, 2005, Gurung, 2012).

Aside from any potential negative impact of fish farming on the environment, knowledge must be taken of the potential positive impact. Boyd and Salie (2011) hypothesized that where irrigation is the main objective of basin water storage for irrigation, enrichment can be beneficial for crop fertilization.

Strengths of the IAI technical

This technique addresses the three notions of sustainable development:

• Economic sustainability: financial stability, business profitability, growth performance of the agricultural sector,

• Socio-territorial sustainability: integration of activity in the area, personal involvement in local life, employment ...

• Environmental sustainability: managing water resources, reduction of waste production, natural soil fertility, environmental protection.

In addition, the strong country Morocco in agricultural development, in full promotion of drip irrigation through the Green Morocco Plan, our country is recognized by:

- Master of breeding aquaculture species.
- Climate and geographical variation where the possibility of raising different species of warm and cold waters.
- The Morocco is a producer of flour and fish oil which will facilitate the manufacture of fish feed.
- Availability of raw materials for fish feed.
- Fish species acclimated for decades.
- Number of basins of irrigation water gradually increasing.
- Increased irrigated by drip surfaces

Conclusion

Opportunities and potential for the integration of irrigation and aquaculture for the development of IIA activities thus exist in Morocco, especially with the Green Morocco Plan, which allows the conversion of surface irrigation to drip irrigation. Integration of aquaculture with irrigation, can promise to be a reliable source of stable income and thus an underlying component of rural food security in Morocco, that promise will be realized with An enabling policy environment, which emphasizes co-management, creates specific plans and actions focussed on fostering sustainable aquaculture, which will allow better optimization of water in the agricultural sector which is experiencing a major boom in Morocco, and this technique will give to the agriculture sector an added value economically, environmentally, socially and even to the point of view health Moroccan citizens.

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