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Quantifying Ecological Sustainability for Melon Agroecosystems at Iran: A Regional Case Study in Khorasan Razavi

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Abstact: **This study was conducted to quantify ecological sustainability of the melon farming system in in some main regions of production systems in khorasan Razavi, Iran. During the 2013 growing season, field surveys were conducted in Torbat-e-Jam and Saleh Abad to obtain information onmanagement, social and economic factors for melon fields. Management factors included melon yield, livestock production, amount of fertilizer and chemical materials, crop residue management, amount of irrigation water used, the level of mechanization and weed management. The mean sustainability index in the melon farming system was 59.34. Among the indicators, the lowest scores were related to livestock production (0.88%), weed management (2.64%), crop residue management (3.72%) and Crop diversity (4.66), respectively. The results of regression analysis showed that the cultivation area, melon yield, farmers' income and access to Inputs, farmers' education level and the improvement and management of Plant debris were the most important factors affecting sustainability index. The study showed that training of farmers, support programs to economic stability, improved crop management and suitable water resource management were a priority for improving melon production system sustainability.**

Keywords: **Sustainability Indicator, Farming Systems, Crop Production, Melon.**

1. INTRODUCTION

The agricultural improvements in 20th century is an indicator of the effort of several generation of Agricultural stakeholders (farmers, advisers, researchers, policy makers). These efforts have caused the increase of the of the global action mean of wheat from 0.9 at the beginning of the 20th century to 2.6 tons in hectares at the end of this century. It also has caused an increase in the rice harvest index from 0.30 to 0.50 [9]. But on the other side, this improvement has lead unpleasant consequences from ecological, social and economic point of view which earn point to the soil drifting, being salt, being acidic and the soil quantitative and qualitative decline, the sources pollution with agricultural chemical materials, the deforestation, the social construction decline, the economic power debilitation and other such phenomena. In the conditions before the agricultural revolution, every hunter gatherer human needs 26 square kilometers for survival, but this area reached to 0.1 hectare for survival at the livelihood agricultural systems in the 20th century [2,3]. It have reported, the amount of the land which was appropriate for providing the food of one person in about 10000 years ago, now provides the food for 3000 persons [3]. This means that the human has daily used the environmental resources compactly which its consequence has been region disturbance and the dissociation of the whole biological circular relations governing the region of the systems especially the region of agricultural systems [3]. The man has affected and has changed the earth environment more than every living creature. Its reason has been the human ability in using the tools that other living creatures lack. The food safety and providing the human primary needs are the most important conflicts of today world [10]. This conflict which is the restrictor of the agricultural crop productions in the regions with the environmental and regional characteristics such as the dry and semi dry regions has taken a double importance and Iran is in climate[7].

It can be concluded from what was discussed that the reconsideration is inevitable in the common agricultural systems and the food production methods according to this, the management of the agricultural systems should be reconsidered seriously and new systems should be designed that their precedence has long lasting stability while maintaining the production in short time [4]. Altogether, the current flow of the agricultural common systems is in a shape which it seems that these systems are not capable of solving the created crisis: welfare has not been provided for all people and the region of the systems is declining. In the new theory, the agricultural crop production should take place with relying on the biologic and ecological foundations, maintaining the material cycle in soil, comprehending and using the biologic complex relation and mixtures, creating self-reliance systems, economic stability of rural societies and maintaining its social structures [12]. The stability indices are low extents which clarifies our viewpoint in relation to the environmental conditions and the stability of the agricultural systems. Through using these indices, one can evaluate the applicability and the quality of the region of the agricultural systems and one can use them as instruments for studying the trends, distinguishing and determining the special environmental conditions and assisting huge decision making in managing the environment [5]. The present research has been performed with the aim of a quantitative survey of the agricultural system stability level of melon in Iran (khorasan province)

and by using a systematic approach. The systematic approach is based on the systematic concept that is defined as a connected system of components which act as a universality in reaction to the exterior agents that affect each of them [11]. This approach analyzes the accomplishment manner of a system (the agricultural system) by considering the coactions of different biological, physical, chemical, social and economic elements [13]. In two recent decades, the systematic approach has been used in designing and managing the agricultural systems widely. The aims of this survey are determining the week and critical point of the studied agricultural systems and presenting suitable method for the stability increase after quantifying a stability index.

2. Material and Methods

This study was done in the area of Torbat-e-Jam and Saleh Abad, Khorasan Razavi province, Iran. Torbat-e-jam has with of 8879 square kilometers in the eastern part of Khorasan Razavi conduced to Sarakhs from the north and to Fariman and Torbat-e-Heydarieh from the west and to Taybad from the south and to Harirod River and to the abutment of both Afghanistan and Pakistan from the east. At first, stability was considered as the consequence of agricultural, ecological, social and economic agents. Then the stability index was designed consisted of 83 measurements in this study. The used measurements can be categorized in 2 groups in this survey: social-economical measurements and agricultural-ecological measurements. Weighted sum model was used for calculating the stability index [6]. Based on this method, a special score is specified for each measurement. These scores belong to various scores of the measurement. In addition, a quantity scope is considered for every measurement which based on that the highest score belongs to the best state and zero score or the lowest score belong so the worst state[8]. After determining, the score of every measurement, the sum score of the measurements to be pluralized and considered as the final score. The high significance of some measurements is. Why a higher score is considered for some measurements, and a lower score for others. Some measurements and their related scores were taken from the references and some of them were also chosen according to the characteristics of the studies system and their related scoring was also considered according to the precedency and the importance of the measurement. After the calculation of the score of the stability index retrogressive step by step analysis was done. For identifying the most important measurement of the stability index assessor from among 83 used measurements. According to this method, the stability index and the studied measurements were chosen and analyzed as a dependant variable and an independent variable comparatively and from among them, the measurements were deleted which their presence had no significant effect in equation on estimating the stability index [1]. Then the equation coefficients of the stability index estimation were calculated using a linear multi-variant regression. This method was also used for determining the effective factors on the generation of the function of the agricultural products. After designing and confirming the measurements, 150 questionnaires were filled by farmers from Torbat-e-Jam and Saleh Abad and it was used after the inspecting and confirming its data. SPSS, Sigma Stat and Excel software's were used for data analysis.

3. Results and Discussion

The average score of the final stability index was 59/34 in the agricultural system of melon. The highest stability score was 73/13 in the melon system and the lowest one was 42/88. The consequences of this survey indicated that as a whole, this system doesn't have a desirable stability. But comparing other studies, it is not in a low level because 38 percent of the farmers had reached a score equal to or higher than 60 and 48 percent had reached to a score equal to or higher than 50 and lower than 60. It reported that the average score of the stability index as 44 in some cities of Khorasan province and in this study, only 0/8 percent of the studied farmers have attained the score of 60 to 69 and 18 percent of them have achieved to the score of 50 to 59 [14]. The reasons for this difference can be reported as the vast segments of the land in Torbat-e-jam, high income because of the extensive land segments and also the personal ownership of most lands. This facilitates the possibility of performing an operation adjusted to the stability principles. Considering table 1, the lowest score of the table belongs to the measurement of the livestock productions but the score of each measurement should be compared according to the highest devoted score which is almost 2/5 for the measurement of the livestock production. Amongst, the measurement which have achieved a low score although the highest score has been given them, there are social-economic measurements, fertilizer and chemical and irrigation materials. Based on a recent study and the available data, some reasons can be mentioned for these matters which are low education level of the farmers, lack of sufficient variety in consuming the fertilizer and chemical materials and low competency of water consumption. If we consider the minimum favorable action of the melon for the farmers based on the costs and the guarantee of the minimum income and also technical competency for 15 tons in each hectare, only 24 percent of the farmers have achieved this level of production. Duo to the recent study consequences and the available data, various reasons can be mentioned for this criterion which can be listed as the low competency of the production process such as low competency of water consumption, regional restrictions and the low level of farmer's education. The relation between the action of the agricultural production and the stability index states this reality that in addition to this factor, other factors also affect the stability index, since in a special action, the stability index score completely differs and fluctuates on different farmers. Namely, the action of the agricultural. Products doesn't numerate as the most essential and only factor determining the stability

among these two agricultural systems, but there are other factors that affect the stability index equally or more than the action of the agricultural products. Basically, the stability index in the melon system was calculated according to all used measurements. For calculating the stability index, the general form of the regression equation namely:

$$Y= f(x_1, x_2 \ldots x_n) \quad (1)$$

Was used and the general linear regression equation:

$$Y= (b_0+b_1x_1+b_2x_2+\ldots b_nx_n) \quad (2)$$

Was used, based on it in which B_1 to B_n fit the coefficients of the independent variables, B_0 fits the constant equation and Y fits the dependent variable.

Then the omission process of unnecessary variables was followed using the retrogressive step by step analysis method. Accordingly, the primary model which was computed by 82 measurements and 100 variables was turned to a simpler model. Based on a restricted number of the original variable that justified the dependent variable changes significantly. For calculating the stability index of the melon system, this model consists of:

$$S.I.=28/65+(0/022*A)+(0/850*B)+(0/004*C)-(1.292*D) +(1.98 *E)+(2.04 *F)+(1.034 *G)-(0/00005 *H)+(1.05 *I) \quad (3)$$

Which indicate: SI stability index, A melon function, B melon under cultivation level, C melon income, D selling the remains, E fungicide variety, F access to Inputs, G access to loan , H other incomes, I insecticide variety. As it can be seen in the formula, the numerical amount of the stability index decreases by other incomes and selling the vestige which indicates the negative effect of the mentioned factors on the stability of this agricultural system. In this formula, the noteworthy point is that the factors such as the consumption amount of the chemical fertilizers did not have a definite effect on the stability index and measurements such as fungicide diversity, insecticidal variety, accessibility to the products and loan had a considerable effect on the final amount of the stability index. Recognizing the critical points of the agriculture systems and the proposed solutions as below:

1. Among the social-economic factors, the level of the farmer's educations is one of the important factors. Because it doesn't seem logical to expect the acceptance of the operation adjusting the stability by the farmers having low education. The farmers education level is partly on an idealistic level, but what is more important is the education related to the agriculture which according to the high number of the agriculture graduates, providing the suitable situation for their engagement in the agriculture section can help the obviation of this crisis.

2. One of very important problems in this investigation is high consumption of chemical fertilizers by the farmers. Considering the high costs devoted to providing and consuming these chemical fertilizers and it is poor effect on the operation increase in the excessive consumption of these fertilizers should be banned so that it should prevent both time and cost consumption and polluting the environment and the agricultural lands by the chemical fertilizers.

3. The study consequences, confirm the frequent previous reports which exist about the low applicability of water consumption. This problem exists in the agricultural systems of khorasan province. One way of increasing water efficiency is using impacted irrigation systems. If one can provide the basis of taking advantage from theses systems by giving financial facilities to the farmers, an extreme section of the problem will be solved surely.

4. Many farmers do not use the green fertilizer, biologic control and also the fodder legume. This matter decreases the biologic diversity in 2 ways. In one hand, the biologic variety of tillage plants and the insects or other factors of the biologic control decreases and on the other hand, many goals and no goal species have been destroyed by the chemical calamity killer. Of course this possibility exists that vast researches have been done in this area and there would be a noticeable data, but anyway, the knowledge production chain towards it is conveyance to the farmers seems discrete.

5. In the present survey, a dominant amount of the farmers income has been from the agricultural activities and this endangers their economic stability in the unpredictable continental contexts of the area which is constantly exposed to the environmental tensions and the production downfall of the agricultural products. The creation of suitable situation for other economic activities in rural agricultural societies such as the simplification of buying the stocks of the alterant industrial factories of the expect product and encouraging the farmers in investing on this area, their economic stability and therefore their biologic system stability will be guaranteed in the inefficient circumstances.

4. CONCLUSION

High irrigation water use, high consumption of chemical fertilizers and pesticides and low organic matter in soils are the main factors affecting suitability index in melon farming system. The results showed that the improvement of farmer's knowledge will accompany producers to help transition from a conventional to a more sustainable farming system.

Table 1- The score of different measurements and the stability index.

Index	The achieved score melon	The score from 100 Final stability index	The achieved score percentage melon
Social-economic	16.36	29.5	55.45
Fertilizer and chemical materials	6.89	14.5	23.35
Management of plant residue	3.72	5.75	12.61
Water and irrigation	7.9	11	26.77

Plowing and Mechanization	10.92	16	37.01
Crop production	5.63	7.5	19.08
livestock production	0.88	2.5	2.98
Agricultural typical diversity	4.66	8.75	15.79
Weed management	2.64	4.5	8.94

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