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Possibilities of Technology Exchanges among Mediterranean Countries with Similar Ecologies

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Abstract. In order to increase food production, the agricultural sector needs appropriate technologies which can be either generated or introduced from other countries. Since the generation of technologies requires a long period, a high amount of input, good planning and successful application, it is a long-term approach. For the short-term, the introduction of technologies could be a better solution. However, the success of introduced technologies in agriculture depends on the ecologic, economic, cultural and social similarities of donor and recipient countries.
Southern and Eastern Mediterranean countries have considerable economic, social and cultural similarities; yet, these can be neglected as limiting factors for technology exchanges. But, similar climate and soil characteristics are assumed to be the most favorable factors for the introduction of agricultural technologies from one country to another.
In this paper, a model, used for defining areas with similar climatic conditions, will be introduced and its application will be discussed in the case of technology exchanges among Mediterranean countries.

Key words. Mediterranean Countries – Climatic Similarity Analysis – Technology Exchange

Titre. Possibilité d'échange de technologies entre les pays méditerranéens ayant des écologies semblables.

Résumé. *Afin d'accroître les productions alimentaires, l'agriculture a besoin de technologies appropriées qui peuvent être soit inventées, soit introduites à partir d'autres pays. Etant donné que la mise au point des technologies demande du temps, un fort niveau d'investissement, une bonne planification et une application réussie, c'est un travail à long terme. A court terme, l'introduction des technologies peut être une meilleure solution. Toutefois, les succès des technologies introduites dans l'agriculture dépendent de l'écologie, de l'économie, des identités culturelles et sociales des pays donneurs et receveurs.*
Les pays de la Méditerranée du Sud et de l'Est ont des similitudes considérables aux niveaux économique, social ou culturel ; cependant, ces facteurs peuvent être négligés en tant que facteurs limitants pour les échanges technologiques. Par contre, des similarités climatiques et des sols présentant des caractéristiques semblables sont considérés comme étant les facteurs les plus importants dans l'introduction de technologies agricoles d'un pays à l'autre.
Un modèle va être présenté – modèle utilisé pour définir les zones ayant des conditions climatiques similaires – et ses applications seront étudiées dans le cas d'échanges de technologie entre pays méditerranéens.

Mots clés. *Pays méditerranéens – Analyse des similarités climatiques – Echange technologique*

I. – Introduction

In our age, science has been improving, new technologies have been produced and the solutions to problems had been discovered before they arose. Therefore, mankind is able to apply new technologies, allowing to increase prosperity and welfare at a very surprising speed. The agricultural sector has benefited from technologic development. And several agricultural products, which had been scarce before, have been overproduced (Hayami, 1984). As a result, using up and selling the products became a serious problem for some countries.

Nevertheless, in some countries and regions of the world, famine is still a problem and some health problems, even death, are due to insufficient food production (Eicher, 1984). Such countries should have appropriate technologies and use them to increase their food production. The process takes place according to different stages, namely : generation or introduction, adaptation, verification, dissemination and utilization (Stuart, 1993) of technologies. Except for the introduction stage, all the others, particularly the generation stage, cover quite a long period and require a high amount of input, good planning and successful application.

For all these reasons, if appropriate technology in a given country is not available, introduction of agricultural technologies into the country concerned from another country (with similar conditions) is one of the best solutions. Usually, countries are reluctant to act as donor only; they prefer to benefit in their turn from technology transfer from other countries. Consequently, in international relations, technology exchanges are more common than one-way introductions. Possibilities of technology exchange among Mediterranean countries will therefore be discussed below.

II. – The Criteria for Exchange of Agricultural Technology

In agriculture, successes of introduced technologies depend on the ecologic, economic and social similarities of donor and recipient countries. The dependence on ecologic similarities is maximum in rainfed agriculture and relatively less in the case of irrigated agriculture, animal husbandry, and crop production in greenhouses respectively, where environmental conditions are from partially to totally controlled.

In the case of two countries with similar ecologic conditions, yet having some economic and social differences, some problems cannot be easily overcome when introducing agricultural technologies from one country to the other. For example, a technology well adapted to the economic conditions prevailing in a given country, may prove inappropriate in another country. Social differences also have to be considered in technology exchanges. In agriculture, then, introducing and exchanging technology can be successfully carried out between ecologically similar countries, or between regions having similar economic and social characteristics.

III. – Examination of Mediterranean Countries in the Light of Similarities

Since Mediterranean countries are in the same geographic position and have the same climatic characteristics (subtropic with rainy winter) (Higgins and Kassam, 1986), they usually have areas with similar ecological conditions. Their similarities are strengthened by the same economical and social peculiarities. Mostly, people of the Southern and Eastern Mediterranean countries have the same history and religion; for this reason, they show very similar social and cultural characteristics. The economies of their countries are highly dependent on agriculture and have great similarities regarding production and consumption patterns. Agricultural enterprises in these countries have common pecularities in respect of size, structure, machinery and equipment. Consequently, the solutions to their problems have to be the same.

Concerning agricultural technology manufacturing, Mediterranean countries, which used to be totally dependent on international organizations, have started to develop their own technologies. Although the technologies developed separately by each country may not always prove appropriate for the others, high potentials of generated technologies can surely be created through technology exchanges between Mediterranean countries.

IV. – Climatic Similarity Model for Exchange of Agricultural Technology

It is assumed, in this paper, that the economic, social and cultural characteristics of the Southern and Eastern Mediterranean countries are similar and are not limiting factors for technology exchange. Their climate and soil characteristics are considered as the most adequate ones for introducing agricultural technologies from one country to another. It is also assumed that there is a big potential of technology exchange among countries showing similar climatic and soil conditions.

For the above mentioned purposes, the model used for defining areas with similar climatic conditions will be introduced and its application will be discussed.

The long term (ten years or more) monthly average temperature, precipitation and relative humidity values, are needed in this recommended model for defining climatic similarities. Before the similarity analysis, their standardized values are estimated by the following formulas (Mizrak, 1990):

$$X_{e,j} = (S_{e,j} - 12.84) / 8.29 \quad (1)$$

$$X_{e,k} = (\text{Log } (YG_{e,j} + 1 - 3.71) / 0.89 \quad (2)$$

$$X_{e,p} = (N_{e,j} - 64.71) / 12.14 \quad (3)$$

In the above formulas:

$X_{e,j}$: Standardized temperature value of j'th month at the station e.

$S_{e,j}$: Long term monthly average temperature value of j'th month at the station e.

$X_{e,k}$: Standardized precipitation value of the j'th month at the station e.

$YG_{e,j}$: Long term monthly average precipitation value of the j'th month at the station e.

$k = j + 12$.

$X_{e,p}$: Standardized relative humidity value of the j'th month at the e'th station.

$N_{e,j}$: Long term monthly average relative humidity value of the j'th month at the station e.

p = j + 24.

Two different methods in the model with the same principles have been proposed to discover climatic similarities. Both methods use the standardized values calculated with formulas 1, 2 and 3.

First Method. The whole Mediterranean area is classified into climatically homogeneous groups by using the standardized values of either the temperature and precipitation or the temperature, precipitation and relative humidity. Areas of different countries in the same climate group are assumed to have similar climatic conditions.

Second Method. In this method, instead of the whole Mediterranean Region, the similarity analysis is carried out for two countries in the following two ways. In the first case, every station of both countries is placed in the analysis.

Table 1. The matrix for standardized values of monthly average temperature, precipitation and relative humidity for climatic similarity analysis of the first country's n stations

Station No.	Standardized Values		
1	$X_{1,1}$	$X_{1,i}$	$X_{1,36}$
2	$X_{2,1}$	$X_{2,i}$	$X_{2,36}$
.			
e	$X_{e,1}$	$X_{e,i}$	$X_{e,36}$
.			
n	$X_{n,1}$	$X_{n,i}$	$X_{n,36}$

In the second case, according to Mizrak (1990), subclimate regions and their representative stations for the two countries concerned are defined and only the representative stations are used in the analysis.

Firstly, one of the two methods above is selected and, accordingly, the stations used in the analysis are defined. If the numbers of the stations are n for the first country and m for the second country, the standardized values of average monthly temperature, precipitation and relative humidity given in two matrixes in *Table 1* and *2* are obtained for the two countries.

As can be seen from formula 4, Difference Measurements (DF = Unstandardized Squared Euclidean Distance) is calculated by using the table values between the two stations belonging to different countries (De Lacy, 1981).

Table 2. The matrix for standardized values of monthly average temperature, precipitation and relative humidity for climatic similarity analysis of the second country's m stations

Station No.	Standardized Values		
1	$Y_{1,1}$	$Y_{1,i}$	$Y_{1,36}$
2	$Y_{2,1}$	$Y_{2,i}$	$Y_{2,36}$
.			
h	$Y_{h,1}$	$Y_{h,i}$	$Y_{h,36}$
.			
m	$Y_{m,1}$	$Y_{m,i}$	$Y_{m,36}$

$$SOÖRU_{e,h} = \sum_{i=1}^{r} 1/r\,(X_{e,i} - Y_{h,i})^2 \qquad (4)$$

In formula 4:

$SOÖKU_{e,h}$: Difference Measurement between the station e of the first country and the station h of the second country.

e = a number between 1 and n
h = a number between 1 and m
r = 24 (in analysis temperature and precipitation are used)
r = 36 (in analysis temperature, precipitation and relative humidity are used)
$X_{e,i}$: the i'th standardized value of the e'th station of the first country.
$Y_{h,i}$: the i'th standardized value of the h'th station of the second country.

The stations with the minimum DF values show that these two stations or their representing areas have the most similar climatic conditions in these two countries.

Beside climatic similarities, soil resemblances should also be taken into consideration in the exchange of agricultural technologies.

V. – Application Possibilities of the Climate Similarity Model

Mizrak (1990) has developed the model and its related software for climate classification and defined

the representative stations of subclimate regions. This model has been successfully used for the climatic classification of Türkiye. The success of the model has already been approved for searching the climatical similarities between Türkiye and Azerbaycan, Syria and Morocco. It could also be applied to define the similar climatic regions of all Mediterranean countries; and this might help technology exchanges among them.

The following procedures are needed to make use of this model for technology exchanges in the Mediterranean Region:

– collecting of climatic relevant data for Mediterranean countries required for the model;

– defining the specific sub-climate types and their distribution in the Mediterranean Region by using the model;

– constituting a data bank of agricultural technologies for specific sub-climatic regions in the Mediterranean Region;

– providing information about agricultural technologies to the member countries for the planning of their technology exchange programs.

The organization and facilities required for the procedures would be constituted and provided within a project supported by national and international institutions.

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