World Applied Sciences Journal 4 (5): 661-666, 2008
ISSN 1818-4952
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Evaluating the Effects of Production Inputs, Climate and Insurance Protection Policy on Income Equality of Wheat Producers in Khorasan Provinces

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Abstract: The purpose of this study is that, whether inputs and insurance protection policy can effect on income inequality or not? The data which was needed for this study was gained by stratified simple random sampling from 573 wheat insured and uninsured farmers in North, Razavi and South Khorasan provinces in 1383. Result of this study showed that wheat farmer's income tends to inequality as among the effective factors in production, land cultivated has the most shares and insurance has the lowest share in inequality. In other words insurance can lead to improve the income distribution. Climate share in income inequality is more than insurance share and climate share in income inequality of uninsured farmers is more than insured farmers. Also income inequality in North Khorasan with cold climate is more than other two provinces and insurance share in income inequality in Razavi with moderate climate is more than other two Provinces. At end of this study with respect to results, some suggestions are offered.

Key words: Income distribution · Shorrocks model · Insurance · Khorasan.

INTRODUCTION

The unprediction nature of natural events has created special conditions for agriculture sector and it has influenced the decisions and quality of operator's activities under its own different aspects [1]. The existence of different kinds of natural and unnatural risks in agricultural activities caused the agricultural output producers to face with uncertain conditions and also it caused the instability of incomes [2]. We can consider some climate factors such as the amount and the time of rainfalls, temperature degree and also the pests and the plant diseases as the most important reasons for agricultural output vacillation and uncertainty in this sector. This vacillation often has great impacts on the amount of products, their price and also on the farmer's income[1]. In fact most of agricultural plans and projects are done in uncertainty and risky conditions. Because of incomes uncertainty, farmers are anxious for loan payback, pay off for fixed costs and more anxious for essential costs of his family. So, it is necessary to decrease the existence of risks through various ways, such as: producing for self consumption, avoidance from applying new technology and diversification in activities and also provide suitable way for farmers' effort to continue and increase producing process with high certainty. In this direction, agricultural insurance in various countries has been used as one of important ways to decrease farmer's income vacillation. Hennessy *et al.* [3] had understood that income insurance has more efficiency in income distribution. Also income insurance is more preferable than the compos ion of product and price insurance. Ghorbani [4] showed that income distribution and amount of this index in sugar beet farmers in insured group is better of uninsured group. Torkamani [2, 5] with the use of Gini coefficient for insured and uninsured wheat farmers, it was shown that agricultural insurance has positive impacts on decrease of inequality agricultural operators. In spite of studies on the role of insurance in income distribution, but until now, we haven't got any research which determines inputs situation, insurance protection policy and climate on income inequality at the same time. So, this study tries to apply this purpose for wheat product in Razavi, Shomali and Jonoobi Khorasan provinces on the base of econometric models.

MATERIALS AND METHODS

At the start of any income decomposition exercise this question arises: What measure of inequality should be chosen for the study? Several different inequality

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measures have been proposed in the literature [6, 7]. According to Foster [8], the chosen measure should have five basic properties of Pigou-Dalton transfer sensitivity, symmetry, mean independence, population homogeneity and decomposability.

Pigou-Dalton transfer sensitivity holds if the measure of inequality increases whenever income is transferred from one person on someone richer. Symmetry holds if the measure of inequality remains unchanged when individuals switch places in the income order. Mean independence holds if a proportionate change in all incomes leaves the measure of inequality unchanged. Population homogeneity holds if increasing or decreasing the population size across all income levels has no effect on the measured level of inequality. The properties of decomposability allow inequality to be partitioned in to either subpopulations or sources. Ideally an inequality measure can be regarded as decomposable source if total inequality can be broken down in to a weighted sum of inequality by various income resources (such as non-agricultural and agricultural income). It seems that, activities which influence a particular source of income are likely to have an effect on other activities that compose total income. Any inequality measure that is a decomposable source must be addressed as a problem of covariance among the income sources [9]. There are several measures of inequality that have the five preceding criteria. These measures include Theil's entropy index T, Theil's second measure L, the coefficient of variation and the Gini coefficient. The two Theil measures, however, are not decomposable when sources of income are overlapping. While the need for groups that do not overlap is not restrictive when inequality is decomposed over geographic regions, this restriction rules out using the two Theil measures in this study because many of the survey households receive income from several different sources.

Shorrocks [10] has shown that the results of decomposing any inequality measure depend on the rule used in the decomposition procedure. In the absence of restrictions, for any inequality measure the inequality of total income can be allocated in many ways between the components of total income. For this reason, it seems best to base the decomposition analysis here on the two remaining inequality measures: the coefficient of variation and the Gini coefficient [10]. According to Shorrocks [10] and Ercelawn [11], the decomposition based on the coefficient of variation can be developed. In this study,we have used Shorrocks model to determine income inequality. So for this purpose, the production function is assumed to Cobb-Douglas form. After expressing the production function in double log-linear form, we can apply Shrrock's decomposition method.

the Cobb-Douglas type is considered rather a restrictive form for a production function since there is no interdependence among different types of inputs. However, under the Cobb-Douglas specification, the logarithmic production value is a summation of linear terms, to which Shorrock's decomposition formulae can be applied [12]. With k as a conventional inputs and m as a variable in dummy form, the production function of wheat farmers in Khorasan province in the Cobb-Douglas form as follows:

$$Y = A\prod_{i=1}^{k} X_i^{\beta_i} \prod_{j=1}^{m} D_j^{\gamma_j} \qquad (1)$$

Where; Y is the total wheat product, A is the intercept, X_i the production inputs such as land cultivated of wheat, hours of machinery use, amount the seed of wheat, phosphate fertilizer, nitrate fertilizer, potass fertilizer, number of irrigation times, number of labor, amount of weed poison, amount of insect poison and D_j represent dummy variables such as climate (Razavi Khorasan, North Khorasan and South Khorasan provinces) and insurance dummy variable. β_i is the output elasticity with respect to product input i and γ_j is the coefficient of j dummy inputs. The logarithmic form of equation 1 is given by:

$$y = a + \sum_{i=1}^{k} \beta_i x_i + \sum_{j=1}^{m} \gamma_j d_j + \varepsilon \qquad (2)$$

Where; lower cases y and x_i indicates variable logarithms.An error term is added to represent stochastic shocks to output and assumed to be unrelated to the other variables.

Following Shorrocks [10], the variance of y in equation 2 is decomposed as:

$$\sigma^2(y) = \sum_{i=1}^{k} \mathrm{cov}(y, \beta_i x_i) + \sum_{j=1}^{m} \mathrm{cov}(y, \gamma_i d_j) + \mathrm{cov}(y, \varepsilon)$$
$$= \sum_{i=1}^{k} \beta_i \,\mathrm{cov}(y, x_i) + \sum_{j=1}^{m} \gamma_j \,\mathrm{cov}(y, d_j) + \sigma^2(\varepsilon) \qquad (3)$$

Where; σ^2 (y) is the variance of y and represent the covariance of y with other variables. Since non of the right-hand side variables in equation 2 are correlated with the error term, the covariance of y is equal to the variance of y. considering that y is in logarithmic form, σ^2 (y) is a standard inequality measure known as the logarithmic variance [13]. According to Shorrocks [10] the covariance to terms on the right hand side of 3 can be regarded as the contributions of each factor in total inequality. Fields and Yoo 10 have used this method to measure labor income inequality in Korea. So by estimating of production function through equation 1 and applying the decomposition in equation 3, we are able to measure the contributions of each factor in income inequality of wheat farmers.

RESULTS AND DISCUSSION

Having said before, in this section, in order to determine of insurance impact and climate conditions on income equality among wheat farmers of Khorasan Province, first the production function of wheat farmers in Cobb-Douglas form was determined. The results are presented in Table 1.

Table 1: Production function estimations in Khorasan Province

Variable	Coefficient	T statistic
Intercept	0.422	3.049*
Land cultivate	1.024	54.290*
Machinery	0.007	0.379
Use of seed	-0.006	-0.250
Phosphate fertilizer	0.115	8.033*
Nitrate fertilizer	0.021	1.144
Potass fertilizer	0.008	1.593
Number of irrigation times	0.149	8.833*
Number of labor	0.004	0.421
Amount of weed position	0.044	3.694*
Amount of insect position	-0.005	-0.433
Amount of animal fertilizer	-0.020	-2.706*
Climate	0.099	-3.688*
Insurance	0.015	0.433
R^2	0.90	

* Significant in 1 percent level

The results of Table 1 shows that Land cultivated, Phosphate fertilizer, Number of irrigation times, Amount of weed position, Amount of animal fertilizer and climate variables are significant and other variables such insurance have not significant relationship with product. Also R^2 =0.9 shows that in this model 90 percent of changes in depended variable is explained with significant in depended imported variables in model. In the other words, 10 percent of changes of in depended variable must be searched in other factors which are not imported in model. In order to estimate production logarithmic variance σ^2 (y) that is known as an index for inequality [13]. The estimated coefficient in production function (coefficients in Table 1) is used and according to the relationship between this coefficient and covariance of coefficient in model (equation 3) the σ^2 (y) is estimated. Production logarithmic variance is 1.46. In other words, inequality of wheat farmers in Khorasan Province is 1.46. This result shows that direction of income distribution is to inequality.

The results of Table 2 shows that among the inputs in wheat product in Khorasan Province, Land cultivated share on farmer's income inequality is more than other inputs. In other word station of this input in production vacillation is very high.

Also Contributions of hours of machinery use (0.0026), seed (-0.0018) and insect position (-0.0018) in farmer's income inequality is the same and also nitrate fertilizer input (-0.0049), potass fertilizer (0.0075) and animal fertilizer (-0.0081) have almost the same contributions in creating income inequality. Among the inputs used in production, an insurance contribution in creating the inequality is lower than other inputs. This subject shows that farmer's purchasing insurance, can lead to improve the income distribution. This result is the same with Ghorbani's [4] results in relation with Sugar beet farmers in Khorasan Province and Torkamani's [2] results in relation with wheat farmers in Fars Province.

Table 2: Contributions of each input factor on wheat farmer's income inequality

Variables	Contributions
Land cultivate	1.1800
Machinery	0.0026
Use of seed	-0.0018
Phosphate fertilizer	0.0494
Nitrate fertilizer	-0.0049
Potass fertilizer	0.0075
Number of irrigation times	0.0370
Number of labor	0.0006
Amount of weed position	0.0310
Amount of insect position	-0.0018
Amount of animal fertilizer	-0.0081
Climate	0.0210
Insurance	-0.0003
Other factors	0.1508

Among the insurance and climate variables, a climate contribution (0.021) in income inequality of wheat farmers is more than insurance contributions (-0.0003). This result shows that climate role in creating income inequality is more significant than insurance role. In the other words, the impact of climate risk is more, so that insurance can not decrease all these risks. Therefore climate role in income inequality is more significant than insurance role.

Table 3: Changes in income inequality as a result of change in each variable

Variables	Insured farmers	Uninsured farmers
Land cultivate	1.032	1.0110
Machinery	0.016	-0.0006
Use of seed	-0.030	0.0740
Phosphate fertilizer	0.128	0.1010
Nitrate fertilizer	0.018	0.0300
Potass fertilizer	0.006	0.0110
Number of irrigation times	0.154	0.1320
Number of labor	-0.002	0.0160
Amount of weed position	0.036	0.0630
Amount of insect position	0.008	-0.0380
Amount of animal fertilizer	-0.028	-0.0060
Climate	-0.113	-0.0840
Intercept	0.502	0.0340

Table 4: Contribution of each factor in income inequality of insured and uninsured farmers

Variables	Insured farmers	Uninsured farmers
Land cultivate	1.1740	1.1960
Machinery	0.0055	0.0002
Use of seed	-0.0101	0.0177
Phosphate fertilizer	0.0577	0.0406
Nitrate fertilizer	0.0066	-0.0008
Potass fertilizer	0.0064	0.0081
Number of irrigation times	0.0469	0.0161
Number of labor	-0.0003	0.0044
Amount of weed position	0.0240	0.0491
Amount of insect position	0.0022	-0.0206
Amount of animal fertilizer	-0.0095	-0.0003
Climate	0.0200	0.0238
Other factors	0.1410	0.1711

Information of Table 3 shows that one percent increase in land cultivated, hours of machinery use, number of irrigation times and amount of animal fertilizer and climate variables on production changes of insured farmers is more effective than uninsured farmers. As a result, increase in each above factor has more influence on income inequality of insured farmers. Also one percent increase in seed, Potass fertilizer, Number of labor, weed position and insect position variables have more effect on production change and income inequality of uninsured farmers than insured farmers.

With the use of information in Table 3, the calculated contribution of each factor in farmer's income inequality of insured and uninsured groups is shown in Table 4.

Based on Table 4, it is considered that among the production inputs, contribution variables machinery use (0.0055), Phosphate fertilizer (0.0577), nitrate fertilizer (0.0066), irrigation (0.0469) and animal fertilizer (-0.0095) in income inequality of insured farmers is more than uninsured ones. But contribution of land cultivated (1.196), seed (0.0177), potass fertilizer (0.0081), labor (0.0044), weed position (-0.0206) and climate (0.0238) in inequality income of wheat uninsured farmers is more than insured ones. In both insured and uninsured groups, contribution of land cultivated is more than other inputs and in insured groups, labor and in uninsured groups the uses of machinery have the lowest contribution. With comparing the climate contribution in two groups, it is observed that climate contribution in income inequality of uninsured farmers is more than insured farmers. This result shows that insurance can decrease the risk of production. Therefore the type of the climate in insured group lead to decrease the income inequality. Amount of logarithmic production variance σ^2 (y) for insured and uninsured farmers is respectively estimated as 1.46 and 1.5. It shows that income inequality in uninsured framers is more than insured farmers.

In order to determine the changes of wheat product percentage in each region, the production function of wheat farmers in cold, moderate and warm climate in the Cobb-Douglas form is estimated. This result is reported in Table 5.

Result of Table 5 shows that one percent increase in most of variables imported in model, has more effects on production changes in North Khorasan farmers than other two provinces farmers. As a result, increase in each factor has more effects on inequality income of farmers in North Khorasan.

Contribution of each factor in farmer's income inequality in cold, moderate and warm climate is reported in Table 6.

The results of Table 6 show that insurance contribution (-0.0029) in income inequality of Razavi Khorasan farmers is more than other two provinces, so that the insurance contribution in income inequality of Jonoobi Khorasan farmers (-0.00002) is not noticable Among the inputs involved in wheat production, contribution of inputs like seed(-0.0102), nitrate fertilizer (0.0286), irrigation (0.1103), labor (0.0212) and weed position (0.0429) in income inequality of Razavi Province farmers is more than farmers in other provinces. But contributions of land cultivated (1.443), machinery use (0.015), phosphate fertilizer (0.141), insect position (0.018) and animal fertilizer (-0.045) in income inequality of North

Table 5: Changes in income inequality as result of change in each variable in each region

Variables	North Khorasan (cold climate)	Razavi Khorasan (moderate climate)	South Khorasan (warm climate)
Land cultivate	1.063***	1.004***	1.047***
Machinery	0.028	0.001	0.013
Use of seed	-0.005	-0.016	0.001
Phosphate fertilizer	0.244***	0.055	0.083***
Nitrate fertilizer	0.023	0.045	-0.026
Potass fertilizer	-0.002	0.009	0.020***
Number of irrigation times	0.113***	0.140***	0.066
Number of labor	-0.009	0.035*	0.050
Amount of weed position	0.020	0.054**	0.025*
Amount of insect position	0.037	0.019	-0.028**
Amount of animal fertilizer	-0.041**	0.016	-0.041***
Insurance	0.054	0.037	-0.021

Table 6: Contribution of factors in income inequality of each region

Variables	North Khorasan (Cold climate)	Razavi Khorasan (Moderate climate)	South Khorasan (Warm climate)
Land cultivate	1.44300	0.98700	1.01000
Machinery	0.01500	0.00003	0.00970
Use of seed	-0.00180	-0.01020	0.00010
Phosphate fertilizer	0.14100	0.03700	0.01630
Nitrate fertilizer	0.00510	0.02860	-0.00370
Potass fertilizer	-0.00340	0.00510	0.01730
Number of irrigation times	0.04900	0.11030	0.00650
Number of labor	-0.01300	0.02120	-0.01090
Amount of weed position	0.01330	0.04290	0.01130
Amount of insect position	0.01800	0.01610	0.00400
Amount of animal fertilizer	-0.04500	0.00120	0.00380
Insurance	0.00110	-0.00290	-0.00002
Other factors	0.22560	0.16980	0.07290

Khorasan farmers is more than other farmers in the Razavi and Jonoobi Khorasan. Also contribution of potasse fertilizer (0.0173) in income inequality of Jonoobi Khorasan farmers is more than other provinces.

Amount of logarithmic production variance σ^2 (y) for farmers in North Khorasan (cold climate), Razavi Khorasan (moderate climate) and South Khorasan (warm climate) is respectively 1.847, 1.40 and 1.137. Therefore farmer's income inequality in North Khorasan with cold climate is more than income inequality in two other provinces. In the other words, cold climate have more effect on farmer's income inequality.

At the end, the results of this study showed that insurance have not significant relationship with wheat production in Khorasan province. Estimation of logarithmic production variance which is known as inequality index showed that wheat farmer's income tends to inequality as among the effective factors in production, land cultivated has most shares and insurance has lowest share in inequality. In other word insurance can lead to improve the income distribution. Also the comparence of insurance contribution and kind of climate in inequality showed that climate share in income inequality is more than insurance share. The comparison of climate share in insured and uninsured groups showed that climate share in income inequality of uninsured farmers is more than insured ones. Logarithmic production variance showed that income inequality of uninsured farmers is more than insured ones. The comparison of insurance share in income inequality in various climates showed that insurance share in income inequality in Razavi with moderate climate is more than other two Provinces. Also income inequality in North Khorasan with cold climate is more than other provinces. It means that cold climate has more effect on increase income inequality. With respect to results of this study, the use of Shorrocks model [10] is offered as a suggestion for study of the impacts of inputs on income inequality, development in agricultural insurance by coveraging risks like climate changes and attention to this variable for indemnity payments and attention to effective factors on income inequality (Land cultivated) and policies in this section by land integration.

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