*Available online at* www.scholarsresearchlibrary.com

**Scholars Research Library**

**Annals of Biological Research, 2012, 3 (6):2718-2726**
*(http://scholarsresearchlibrary.com/archive.html)*

**ISSN 0976-1233**
**CODEN (USA): ABRNBW**

# Conversion to Organic Arable Farming in Iran

**Alireza Karbasi[1], Mostafa Kojouri Geshniyani[2], Behzad Fakari Sardehaee[2], Zahra Rezaei[3]**

*[1]Department of Agricultural Economics, Ferdowsi University of Mashhad*
*[2]Department of Agricultural Economics at Ferdowsi University of Mashhad*
*[3]Department of Agriculture, Mashhad Branch, Islamic Azad University, Mashhad, Iran*

---

**ABSTRACT**

*The objective of this paper is to develop a dynamic linear programming model to analyse the effects of different limiting factors on the conversion process of farms over time. The model is developed for a typical arable farm in The Mazandaran, and is based on two models, conventional and organic. The objective of the model is to maximize the net present value over a 10-year planning horizon. The data for analysis has collected from the Agricultural Research Organization of Mazandaran province in 2011. The results of the analysis of a basic scenario show that conversion to organic farming is more profitable than staying conventional. Sensitivity analysis shows that if depreciation is 25% higher than conventional fixed costs due to machinery made superfluous by conversion, conversion is less profitable than staying conventional. Also the availability of hired labour has a strong effect on the cropping plan and the amount of area converted. Further analysis shows that a slight drop (2%) in organic prices lowers the labour income of the farmer and makes conversion less profitable than conventional farming. For farmers, a minimum labour income can be required to 'survive'. The analysis shows that constraint on minimum labour income makes stepwise conversion the best way for farmers to overcome economic difficulties during conversion.*

**Keywords:** Organic farming; Net Present Value; Conversion; Dynamic linear programming; Mazandaran.

---

## INTRODUCTION

Excessive use of chemical inputs in crop production process is an issue that threatens the health of consumers and imposes its adverse effects on nature. Lack of information among policy makers and farmers on the economic potential of organic arable production is one of the obstacles to develop organic farming. In order to stimulate the conversion, policy makers need more detailed information about the process of conversion. Several studies in Europe and in US showed that economic performance of organic farms is similar to comparable conventional farms (Mahoney et al., 2004; Eltun et al., 2002; Offermann and Nieberg, 2000; Lampkin and Padel, 1994). However, significant differences in economic performance occur between different studies, countries and between farm types.

Berentsen et al (2007) analysed convention a land organic arable farming in the Netherlands from a technical, economical and environmental point of view. This study showed that in equilibrium states organic farming is much more profitable than conventional. Mather et al (2007) compared organic and conventional wheat production in 21 years and reported a decrease of 14 percents in the performance of organic terms. Offermann and Nieberg (2000) concluded that organic arable farms show remarkably high profits relative to comparable conventional farms, mainly due to lower input costs that compensated for reduced outputs. Kocheki et al (2004) reported 30% drop in performance for some farms in the conversion period. They concluded by an appropriate frequency, the fertility of land increases, thereby performance increases.

Different modelling approaches have been used to study conversion, but the majority of normative studies have not included the time aspect in the model (Berentsen et al., 2005). The inclusion of time is, however, important since the conversion process from conventional to organic farming takes at least 2 years. Besides one-step conversion (conversion of all land area at once), farmers can also choose stepwise conversion. This gives farmers more time to adapt to the new production method and ensures income by still allowing production of conventional products next to the in-conversion products during the conversion period.

In next section the model is used to analyse different factors influencing the conversion, such as extra depreciation costs, hired labour availability, organic market price uncertainty and minimum labour income requirement.

## MATERIALS AND METHODS

*2.1. Model specification*

In order to analyse the conversion from a conventional to organic farming system over time, a dynamic linear programming (DLP) model was developed for a typical arable farm in the Mazandaran in the north of Iran. The general structure of the dynamic linear programming model is summarised as follows (Hazell and Norton, 1986):

$$Max \qquad Z = \sum_t \delta_t \left[ \left( c_t' x_t \right) - f_t \right]$$

$$s.t.: \qquad A_t x_t \le b_t$$

$$and \qquad x_t \ge 0$$

where Z is the discounted labour income (Rial); t is the year [1, … , 10]; i is the discount rate (%); x stands for the vector of activities; c is the vector of gross margins or costs per unit of activity (Rial); f is the vector of fixed costs per year (Rial); A is the matrix of technical coefficients; b is the vector of the right-hand side value and $\delta_t = \left(1/(1+i)\right)^{t-1}$.

Activities and constraints are included in each period (year) for all the relevant decisions and many of them are duplicated from 1 year to the next (e.g., annual crop activities). The link between the years is provided by the conversion of the land area and the objective function.

The planning horizon has been arbitrarily limited to 10 years in order to examine the conversion process of the farm. The conversion itself takes 2 years if the farmer decides to convert at once, but longer in the case of stepwise conversion. This means that the farm has the option to convert completely, partially, or not at all, depending on the sum of the discounted labour income over the 10 years planning horizon.

The general structure of the model part for one particular year is shown in table 1. This table shows that the activities in the model are production activities representing different crops, seasonal labour, purchase of fertiliser and manure, activities calculating nutrient surplus, organic matter input and pesticide use. These activities and the connected technical coefficients are either conventional, conversion, or organic, depending on the stage the farm is in.

There are some technical constraints determining the dynamic aspect of the complete 10-years model. The first year in the model is restricted to conventional production only. This restriction was imposed in order to compare the conventional production plan with the conversion and organic production plan. From the second year on, the model can convert to organic production. In case land goes into conversion, it will be so for 2 years, and then become organic land area. The model determines how much land should go from conventional into conversion. In the model, the conversion is restricted to a one-way direction, excluding the possibility of converting back to a conventional system.

The objective function of the model is to maximise the sum of discounted labour income over the 10-year planning horizon, where the annual labour income is discounted to the first year. In the basic scenario, we assume a 4% discount rate. Labour income is the household income, which includes revenues from crops produced, minus variable and fixed costs. Variable costs are direct crop-production costs (variable operations, pesticide use, energy use, contract work, marketing costs and other costs), costs of purchased nutrients (manure and fertilisers), hired labour costs and nutrient taxes. Fixed costs include costs of land, machinery and buildings.

The DLP model was built in GAMS (General Algebraic Modelling System) programming language and solved by the CoinCbc solver.

**Table 1. The general structure of arable farm model for one particular year**

| Activities | Crop production for sale | Seasonal labour | Purchase of fertiliser | Purchase of manure | Nutrient surplus | Organic matter input | Total pesticide use | Fixed costs | |
|---|---|---|---|---|---|---|---|---|---|
| Constraints | | | | | | | | | |
| Land availability | +1 | | | | | | | | ≤Available land |
| Rotation restrictions | +1 | | | | | | | | ≤ Max. ha of each crop or group of crops |
| Labour in each month | +aij | −1 | | | | | | | ≤Available fixed and seasonallabour |
| Fertiliser and manure requirements | +aij | | −aij | −aij | | | | | ≤ 0 |
| Nutrient balances at farm level | −aij[a] | | +aij | +aij | −aij | | | | = 0 |
| Linking production activities and pesticide use | +aij | | | | | | −1 | | = 0 |
| Organic matter input | +aij | | | +aij | | −aij | | | = 0 |
| Fixed costs | | | | | | | | 1 | = 1 |
| Objective function | Gross margin (Rial) excl. cost of fertiliser | Cost (Rial/day) | Cost (Rial /kg) | Cost (Rial/ Mg) | | | Annual costs (Rial) | | |

*aij – the technical coefficient that relates activity i to the constraint j.*
*a Corrected for nitrogen fixation by legumes.*

*2.2. Input data for the model*

Input data for the model was taken from a typical conventional and organic arable farm in Mazandaran with an average area of 50 ha. This farm can produce conventional and organic crops. In the case that the farmer decides to produce in the conventional way, he can choose from winter wheat, spring barley, strawberry, ware potatoes, seed potatoes, onion, and carrot (see Table 2).

**Table 2. Yield, costs, revenues, labour and nutrient requirements of conventional crops per hectare per year (source: Agricultural Research Organization of Mazandaran)**

| Crops | Conventional | | | | |
|---|---|---|---|---|---|
| | Revenue (Rial) | Costs[a] (Rial) | Labour need (h) | Nutrient requirement | |
| | | | | N (kg) | $P_2O_5$ (kg) |
| Ware potato | 24000 | 7100 | 25 | 255 | 120 |
| Seed potato | 32500 | 13700 | 65 | 125 | 120 |
| Strawberry | 14000 | 4200 | 20 | 110 | 70 |
| Onion | 22000 | 8300 | 31 | 110 | 120 |
| Carrot | 51000 | 40000 | 23 | 80 | 120 |
| Winter wheat | 7600 | 2000 | 22 | 210 | 20 |
| Spring barley | 6950 | 1300 | 25 | 65 | 20 |

[a] *Direct production costs – do not include the costs of nutrients and labour.*

**Table 3. Yield, costs, revenues, labour and nutrient requirements of conversion and organic crops per hectare per year (source: Agricultural Research Organization of Mazandaran)**

| Crops | Conversion and organic | | | | | |
|---|---|---|---|---|---|---|
| | Conversion Revenue (Rial) | Organic Revenue (Rial) | Costs[a] (Rial) | Labour need (h) | Nutrient requirement | |
| | | | | | N (kg)[b] | $P_2O_5$ (kg) |
| Ware potato | 11600 | 30000 | 9500 | 21 | 150 | 48 |
| Weed potato | 22000 | 40600 | 9400 | 70 | 50 | 47 |
| Strawberry | 10800 | 17100 | 3700 | 65 | 55 | 120 |
| Onion | 13300 | 37000 | 5400 | 35 | 50 | 43 |
| Carrot | 37000 | 79000 | 52500 | 25 | 40 | 57 |
| Winter wheat | 5250 | 8100 | 1850 | 30 | 125 | 62 |
| Spring barley | 5200 | 7100 | 1600 | 22 | 25 | 60 |
| Winter barley | 4400 | 7400 | 1400 | 25 | 75 | 53 |
| Spring wheat | 5600 | 9200 | 1700 | 36 | 75 | 62 |
| Kidney bean | 6350 | 11900 | 2600 | 26 | 50 | 20 |
| Green pea | 4480 | 11600 | 2800 | 23 | 10 | 25 |
| Alfalfa | 3500 | 4000 | 750 | 10 | 0 | 133 |
| Celeriac | 10300 | 35400 | 11300 | 18 | 140 | 74 |
| Grass-clover | 2300 | 3000 | 600 | 12 | 0 | 105 |

[a] *Direct production costs – do not include the costs of nutrients and labour.*
[b] *N-fixation by legumes is included separately as an input (kidney bean 100, green pea 200, alfalfa 528, grass-clover 160 kg/ha).*

In the case he decides to convert to organic farming, he has to farm 2 years in the organic way and for conventional prices before he can receive organic prices (Berentsen et al 2005). The organically-grown crops are the same crops as grown conventionally plus others such as spring wheat, winter barley, kidney bean, green pea, alfalfa, and grass-clover during and after conversion (see Table 3). The latter crops are not included in the conventional plan because they are not produced conventionally in this region. Organically-produced crops grown during the 2-year conversion period are called "conversion crops", and after conversion, "organic crops".

All the individual crops and groups of crops have their own rotation constraints which are mainly agronomic. For conventional production, three-course crop rotation is used for the whole land area, which characterises the region. For conversion and organic production, six-course crop rotation is used. This more diverse crop rotation is a requirement of organic farming. An additional constraint is the requirement of legume crops in the organic rotation – a minimum 1/6 of the area cultivated. This restriction assures a minimum area in legume crops which contribute to soil organic matter, nutrient supply (nitrogen fixation) and improved yield in following organic crops ( [Power, 1987] and [Dabbert and Madden, 1986] ). It is also suggested by advisors and commonly practised ( [Parr et al., 1983] and [De Wolf and De Wolf, 2004] ).

The model input data on conventional, conversion and organic revenues, costs, labour, nutrient and pesticide use per crop in Mazandaran were collected from the Agricultural Research Organization of Mazandaran. This information (except on pesticide use) per crop per hectare is summarised in Table 2 and Table 3. The revenues from the crops are calculated by multiplication of crop prices and yield per crop. The direct costs of crop production include the costs of field operations (land preparation, planting and sowing, crop care, hand weeding and harvesting), costs of pesticide (in the conventional case) and energy use, and other costs such as interest, insurance and N-mineral sampling. These costs do not include the costs of nutrients and labour. For conversion crops, organic production yields, organic costs, labour and nutrient use and conventional crop prices were used. For conversion crops in some cases, higher prices can be received; however, it is not a common phenomenon and no exact information is available on those prices.

Since most field operations on crops have to be performed during a certain period, the year is divided into periods of months. The available amount of family labour is assumed to be 1.1 full-time labour (330 Labour per day), which is an average labour supply in this region for a 50-ha arable farm (Agricultural Research Organization of Mazandaran). The family labour supply per period is assumed to be constant over the year. In peak periods however household labour can supply a maximum of 28 Labour per day /month. Apart from family labour there is seasonal hired labour. Hired labour can be employed any time of the year for different field operations (land preparation, planting and sowing, crop care, hand weeding and harvesting)

In general, organic crops require significantly more labour than conventional crops, mainly due to the greater amount of work done by hand (i.e., weed control, pest control, harvesting by hand) including increased crop supervision. However, some crops such as seed and ware potato need less labour in organic production, since hand weeding is less work than chemical application. This greater labour demand also means more general work for farmers, i.e. maintenance of machinery, fields, administration. In the basic scenario it is assumed that the availability of hired labour is unrestricted, and that there is no additional need for the family labour to get extra information and education concerning organic production methods, which requires more time and costs during the conversion period (no "learning curve" effect).

The fixed costs, based on those of a farm in this region with a 50-ha land area – basic machinery, buildings and typical cropping plans – are calculated separately from the LP model. These costs are related to the type of farming: conventional fixed costs (380 million Rials/year) are valid for conventional production and organic fixed costs (387 million Rials/year), for conversion and organic production years [20]. The higher fixed cost in organic farming arises from higher building costs and higher other fixed costs. There was no distinction made between conversion and organic fixed costs because fixed costs mainly depend on the production method used and the average cropping plan on the farm. In this case, in both conversion and organic production, the organic production method is applied.
In order to convert to organic farming, farmers have to adjust their technology to the new production system and invest in new machinery and buildings. Machinery made superfluous by conversion can cause disinvestment if there is little or no possibility of selling them. In the basic scenario, however, it is assumed that no disinvestment takes place.

*2.3. Model output*
The solution of the model provides a decision strategy at the farm level, including the number of hectares of each crop to be grown every year, and how many hectares to convert in the case of conversion. Next to the optimal production plan it provides information on labour allocation, nutrient and pesticide purchase, nutrient losses, organic matter input to the farm and the economic consequences of production.

2.4. Set-up of the calculations
First, calculations are made for the basic scenario as discussed in the previous sections. Next, a sensitivity analysis determines the effects of some additional limiting factors on the results by means of parametric programming. In this analysis the break-even point, farm conversion or non-conversion, and the type of conversion (partial or complete, and one-step or stepwise) is determined. The factors studied are disinvestment, hired seasonal labour availability, lower organic prices and minimum labour income requirement. This results in four additional scenarios:

1. The disinvestment scenario: The assumption was made that, in the basic scenario, no disinvestment occurs during conversion from conventional to organic farming. With disinvestment the farmer has to calculate extra depreciation cost, which means an increase in fixed costs during the years after switching to organic production. Disinvestment arises if a machine (e.g. a pesticide sprayer) cannot be used anymore and it can also not be sold because of lack of interest. To investigate the effect of extra depreciation costs on the farmer's labour income and on the decision whether to convert or not to organic farming, this disinvestment scenario is analysed. In this scenario extra depreciation costs for the conversion years (2 years after the switch) were applied. The break-even point is determined by a stepwise increase in the extra depreciation costs.
2. The hired-labour limit scenario: In the basic model, no limit on hired-labour availability was assumed. In some regions (with a lot of organic farming or other labour-intense activities), the availability of labour can be a problem, mainly because of the low skill requirements and the usually boring work (done mainly by hand) on

organic farms (De Wolf and De Wolf, 2004). In order to analyse the effect of the seasonal labour availability in the region, the hired-labour availability is stepwise increased per month.

3. The lower organic price scenario: In the basic scenario, it was assumed that the farmer gets higher prices for organic products than for conventional, and that the prices are certain. However, in practice, organic market uncertainty and price risk is an important factor in the decision to convert or not. In order to analyse how a drop in prices (i.e., the farmer cannot receive higher organic prices) would influence the conversion, this lower organic price scenario is tested. The prices of organic products are decreased stepwise.
4. The minimum labour income scenario: In the basic set-up of the model, we assumed no minimum labour income requirement for the whole planning horizon. However, financial difficulty during conversion to organic farming can be substantial due to lower revenues and higher costs. To test this, a minimum bound is set for the labour income for each year. In order to find the break-even point at which the farmer switches to organic production, this minimum bound is increased stepwise.

## RESULTS AND DISCUSSION

*3.1. Optimal cropping plan*

The optimal cropping plan of the farm over a 10-year planning horizon can be seen in Table 4. The optimal strategy for the farm would be to convert the whole land area to organic production in the second year (the first year is fixed as conventional). This means 2 years of cultivating organically for conventional prices. Afterwards, the farmer gets organic prices for organic production.

**Table 4. Optimal production plan of the farm over 10-year planning horizon (ha/year)**

| Crop | Year | | |
|---|---|---|---|
| | 1 | 2-3 | 4-10 |
| **Conventional** | | | |
| Spring wheat | 14 | - | - |
| Seed potato | 3.8 | - | - |
| Ware potato | 12.5 | - | - |
| Onion | 12 | - | - |
| Carrot | 7.7 | - | - |
| **Conversion** | | | |
| Spring wheat | - | 14.6 | - |
| Seed potato | - | 5 | - |
| Onion | - | 9.4 | - |
| Strawberry | - | 11.5 | - |
| Alfalfa | - | 9.5 | - |
| **Organic** | | | |
| Spring wheat | - | - | 8.4 |
| Seed potato | - | - | 5 |
| Onion | - | - | 9.3 |
| Carrot | - | - | 12 |
| Kidney bean | - | - | 8.3 |
| Green pea | - | - | 7 |

In the first conventional year, winter wheat, seed potato, ware potato, seed onion and carrot are produced in a 3-year crop rotation. Seed potato and seed onion brings the highest gross margin compared to other conventional crops.

In the second year, according to the model, the farm converts at once and the crops are cultivated organically. During the 2 years of conversion, a different cropping pattern is planned, with spring wheat, seed potato, seed onion, sugar beet and alfalfa, an optimal plan for the farmer from the economic point of view. The differences, compared to the conventional cropping plan, consist of the crop rotation restrictions, which are six-course (as in organic years) instead of three-course, the minimum legume requirement of 1/6 of the area, the lower yields, conventional prices, and the difference in the costs of production for the same types of crops (see Table 4).

After the 2 years of conversion, higher prices are available for organically-produced crops. This is the main difference between conversion-year crops and crops produced in the organic year.

*3.2. Technical results*

The output of the model shows that the household labour is fully used in the whole 10-year planning horizon. In conversion from conventional to organic farming there is an increase in the labour demand because of the more diverse crop rotation, greater amount of manual work and general work during the organic production years.

In organic years, besides carrot (which increases from 4 to 8 ha), seed potato is the most labour-intensive crop. Both crops need the most labour during July and August due to mechanical weed control.

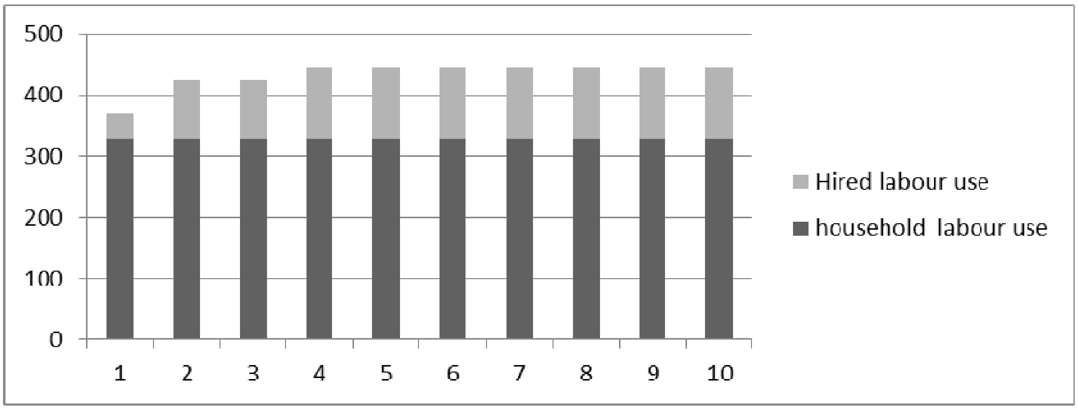


**Fig. 1. Total labour use before, during and after conversion.**

Fig. 1 shows the labour requirements over the years. In conversion years, more labour is needed for crops such as strawberry, kidney bean and spring wheat than in the conventional year. In organic years more labour is required by crops such as seed onion and carrot: 36 Labour per day/month for seed onion and 29 Labour per day/month for carrot, in peak periods. By adding up all the labour needed in the summer period for all the crops grown, the total labour requirement is around 70–80 Labour per day/month (Fig. 2). This means that in this period, at least 7–8 additional units of labour (one unit is 10 Labour per day/month) are needed, besides the family labour (28 Labour per day/month). By comparison, in conventional production one additional labour unit is required at the maximum during the harvesting period.

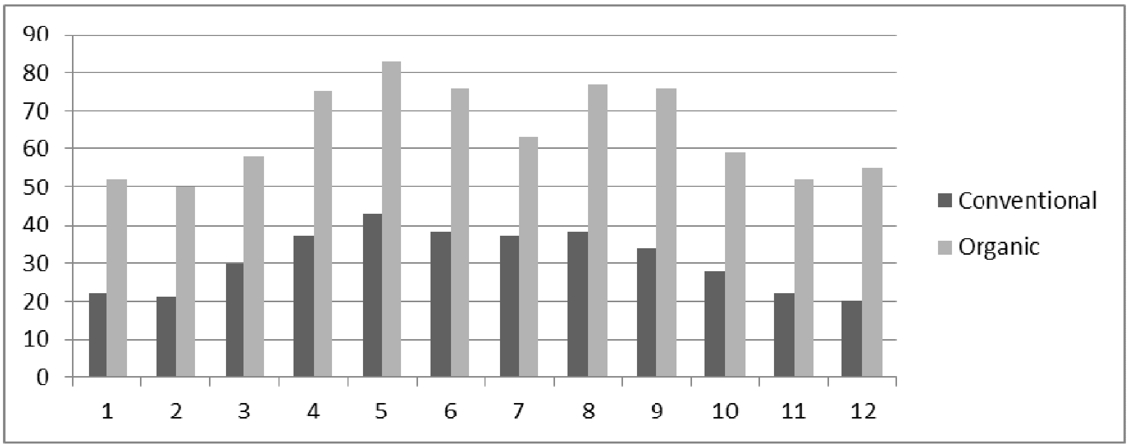


**Fig. 2. Labour use per month in conventional and organic farming.**

*3.3. Economic results*

The economic results (Fig. 3) show that organic crop production brings two times more labour income than conventional production. In light of this, most farmers would probably convert to organic, if not for the attendant economic challenge posed by the 2-year conversion period with lower yields at lower, conventional prices and consequent negative labour income. Farm revenue comes from sales of crops grown on the farm. In the conversion years revenue is much lower than that of conventional and organic years, because of the different cropping plan, lower (organic) yield and conventional prices during the 2 years. Although yields are lower in organic farming, the higher prices for organic products after conversion result in higher returns from organic crop production in comparison to returns in conventional and conversion years.

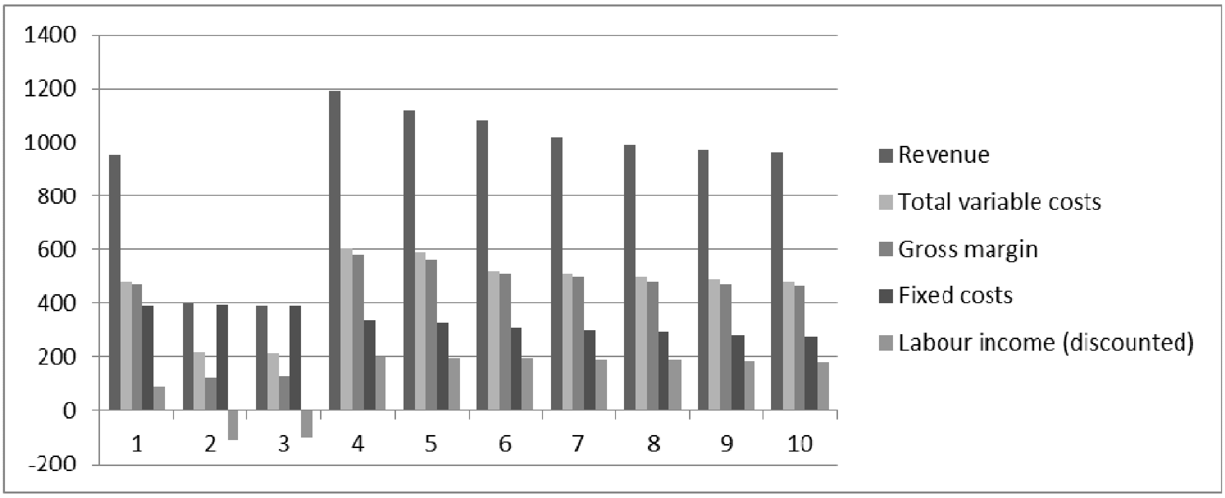


**Fig. 3. Economic results from the DLP model at 4% discount rate.**

Farm variable costs refer to the direct costs of crop production (see Table 2 and Table 3), as well as costs of hired labour, manure and fertiliser purchases. In the conversion years variable costs are two times lower than in conventional years. The lower variable costs in conversion years result from "cheaper" crops grown in this period, i.e., the lower revenues from these crops.

In the conventional year, 89% of the variable costs are direct costs of crop production, and only a small amount is for hired labour and nutrient purchase. In the conversion years direct costs are 60% and hired labour are 34% of the total variable costs. In organic years these figures are 74% and 22%, respectively. The remaining few percent are for nutrient purchase. These differences are explained by the omission of pesticide use, which lowers the direct costs of crop production and increases the labour requirement in organic farming. The costs of manure and fertiliser are lower due to the more extensive farming and the total omission of chemical fertilisers in organic production.

*3.4. Sensitivity analysis*

Sensitivity analysis was used to determine the effects of four limiting factors on the basic model results. The main results can be seen in Table 5.

**Table 5. Ranges in different types of conversion for four different scenarios**

| Break-even points | Disinvestment (% of conventional fixed costs) | Hired-labour limit labour per day/month | Lower organic price (% reduction) | Minimum labour income (million Rial) |
|---|---|---|---|---|
| No conversion | ≥ 25% | 0 - 20 | ≥ 2% | ≤ 0 |
| Partial conversion | - | 20 – 50 | - | 0 - 64 |
| Complete conversion (basic) | 0 – 25% | ≥ 50 | 0 – 2% | ≥ 64 |

The first limiting factor in the analysis is called "disinvestment". If the extra depreciation cost is between 0% and 25% of the conventional fixed costs, then complete conversion takes place. The results differ from the basic scenario only in the amount of discounted labour income, which falls as extra depreciation costs rise. If the extra depreciation cost is higher than 25% of the conventional fixed costs, then there is no conversion to organic farming.

The second limiting factor in the analysis is called "hired-labour limit". The basic scenario remains unchanged when the hired-labour availability is higher than 50labour per day/month. If more than 20 but less than 50labour per day/month of hired labouris available, then there is still total conversion to organic farming then there is partial conversion to organic farming. If there is less than 20 labour per day/month hired labour available then there is no conversion to organic farming.

The third limiting factor in the analysis is called “lower organic price”. If the prices for all organic products drop less than 2%, then there is still total conversion to organic farming. The results are the same as in the basic scenario; only the revenues are lower for organic products. If the prices for all organic products drop more than 2%, then there is no conversion to organic farming.

The fourth limiting factor in the analysis is called “minimum labour income”. There is complete conversion to organic farming until the minimum labour income is restricted to −64 million Rials/year. If the minimum labour income requirement is higher than −64 but lower than 0 million Rials/year, then there is partial conversion to organic farming. If it is higher than 0 million Rials/year then there is no conversion to organic farming.

## REFERENCES

[1] Barry, P.J., Ellinger, P.N., Hopkin, J.A., Bake, C.B., **2000**. Financial Management in Agriculture, sixth ed. Interstate Publishers, Inc., USA, p. 678.
[2] Berentsen, P.B.M., Huirne, R.B.M., **2005**. *Wageningen Journal of Life Sciences*, NJAS 53-1.
[3] Berentsen, P.M.B., de Wolf, M., Huirne, R.M.B., *Biological Agriculture and Horticulture*.
[4] Dabbert, S., Madden, P., **1986**. *American Journal of Alternative Agriculture* 1 (13), 99–107
[5] De Wolf, M., De Wolf, P., **2004**. Personal Communication. Praktijkonderzoek Plant en Omgeving, Lelystad, The Netherlands.
[6] Eltun, R., Korsath, A., Nordheim, O., **2002,** *Agriculture, Ecosystems & Environment* 90 (2), 155–168.
[7] Hazel. P.B.R., Norton. R.D., O., **1986**. Mathematical Programming for Economic Analysis in Agriculture. Macmillan Publishing Company, New York.
[8] Koocheki, A. (**2004**). *Cultural science letter* , 24 - 25:55-95.
[9] Mader, P., D. Hahn, D. Dubois, L. Gunst, T. Alfőldi, H. Bergmann, M.Oehme, R. Amado, H. Schneider, U. Graf, A. Elimirov, A. Fließbach and U. Niggli (**2007**) *Journal of Sci. Food Agric*.,87:1826–1835.
[10]Mahmoudi, H., A.M. MahdaviDamghani and H. Liaghati (**2008**). *An Introduction to Organic Agriculture*. Mashad: Jihad-Daneshgahi Press.
[11]Mahoney, P.R., Olson, K.D., Porter, P.M., Huggins, D.R., Perillo, C.A., Kent Crookston, R., **2004**. *Renewable Agriculture and Food Systems* 19 (1), 35–46.
[12]MANMF (Ministry of Agriculture, Nature Management and Fisheries), **2004**. Wetsvoorstel aanpassing verliesnormen naar Tweede Kamer, Available from: <www.minlnv.nl/1persberichten/Mestloket>. Accessed 28 January 2004.
[13]Melita, F., **2001**. Organic Farming in the Netherlands – Country Reports. Vailable from: Accessed 23 April 2006.
[14]MINLNV, **2005**. Ministry of Agriculture, Nature and Food Quality. Available from: <http://www.nlpekagr.com/>. Accessed 20 April 2006.
[15]Morris, C., Hopkins, A., Winter, M., **2001**. Comparison of the social, economic, and environmental effects of organic, ICM and conventional framing. Final report to The Countryside Agency, Institute of Grassland and Environmental Research, UK, p. 152.
[16]Offermann, F., Nieberg, H., **2000**. Economic performance of organic farms in Europe. Organic farming in Europe: Economics and Policy, vol. 5. Universitaet Hohenheim, Stuttgart, Hohenheim, Germany.
[17]Power, J.F., **1987**. *American Journal of Alternative Agriculture* 2 (2), 69–73.
[18]S. Acs, P.M.B. Berenstan , R.B.M. Huirne. *Agriculture System* 94 (**2007**) 405-415
[19]Wijnands, F.G., Dekking, A.J., **2002b**. Geı¨ntegreerde akkerbouw, central zeeklei. PPO-Bedrijfs system en 2002, no. 4. PPO, Lelystad, The Nethelrands..
[20]Yearbook of Agricultural Research Organization of Mazandaran, Iran. **2011**.
[21]Yussefi, M., Willer, H., **2002**. Organic Agriculture Worldwide **2002**:Statistics and Future Prospects. SO ¨ L (Foundation of Ecology andAgriculture), Bad Du ¨ rkheim, 157pp.