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# The Comparison of Farming Inputs Consumption in Traditional and Developed Paddy Fields in Iran

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**Abstract** The most important of Land-consolidation programs is to decrease consumption of chemical inputs (fertilizer and toxins) in paddy fields, thus enhancing sustainability. This study compares the consumption of inputs in traditional and developed paddy fields in Iran, based on a case study of Gilan province. The research was conducted in the form of a survey study. The data for this research was collected from 176 farmers who work traditional rice fields and 188 farmers who are part of a farm-development program in Gilan province, who were selected using a stratified random sampling procedure. Data was collected through a questionnaire. The reliability of questionnaire was determined by calculating the Cronbach's alpha coefficient (0.75) after conducting a pilot study. Analysis of the survey results showed that the average consumption of chemical fertilizer in developed paddy fields (363 kg of fertilizers per hectare) was greater than that in traditional paddy fields (308 kg/ha). In contrast, developed paddy fields used less toxins (6.4 kg/ha) than traditional paddy fields (8.3 kg/ha). The t-test showed that in two groups of farmers, the farmers of developed paddy lands used significantly more chemical toxins and manure, and significantly less chemical fertilizer, than farmers of traditional paddy lands.

**Keywords** Sustainability Consumption, Chemical Inputs, Paddy Fields, Gilan Province

## 1. Introduction

Land consolidation is a common feature of agriculture in many countries, especially in developing countries[20]. The lack of land consolidation can be considered as an obstacle to efficient farm management, as it leads to smaller parcels over time as well as the physical dispersion of parcels owned or worked by the same farmer[5]. Consolidation is a spatial problem-solving technique whereby landowners are obliged to surrender their scattered plots in order to receive an equivalent area or value of land in fewer and larger plots. In transition countries, land consolidation is one of the most important fundamentals for helping to resolve the structural problems in agriculture and agricultural production. It can be seen as a "secret weapon for economic growth and shared wealth"[15], particularly when supported by policies and schemes for new infrastructure such as irrigation systems. Several factors have been generally cited as causing or contributing to involuntary fragmentation[3]. Many authors argue, for example, that particle inheritance logically leads to fragmentation when farmers desire to provide each of several heirs with land of similar quality (ibid). Furthermore, the trend toward increasing population may lead to fragmentation as farmers in search of additional land will likely accept any available parcel of land within reasonable distance of their house. Inefficient land markets and state laws that restrict transactions can be also one of the major causes for fragmentation. Climate and environment can also contribute to fragmentation on the supply side[5].

Land consolidation not only increases production efficiency, it also lowers costs inherent in fragmentation, such as extra labour, more fuel inputs for traveling between plots, more waste due to increased leakage and evaporation of fertilizers, water, pesticides, etc.). It also reduces the need for infrastructure such as irrigation and access routes, reduces investments in soil conservation, reduces land lost to borders and reduces the potential Paddy-field improvements represent an important technical and political measure to achieve sustainable development of agriculture, reconciling the demands for food production and environmental conservation[18]. Sustainability is now being encouraged in all aspects of development. Several investigations have defined sustainable agriculture. These definitions differ from region to region, and researchers have yet to agree as to what actually they mean by sustainable agriculture[7]. Sustainability can be divided into three aspects: economic, social, and environmental. The economic aim of land consolidation in

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paddy fields is to improve their infrastructure by combining small, irregular plots into larger plots; building irrigation and drainage canals, roads between farms and drainage systems; increase workforce productivity and reduce wasted labor in scattered plots; and enhance mechanization. The social aim is to reduce the onerous nature of farm work by improving farm management systems; improving rural community life; instituting flood control; increasing the efficiency of public systems such as roads, rivers and sewage systems; and developing community food security through the consolidation and diversification of food production. The environmental aim is to prevent soil erosion and land degradation, reduce chemical inputs (particularly fertilizers and pesticides), stabilize water flows in large streams, reduce flood damage and maintain the land's visual appeal.

### 1.1. Conceptual Framework

An agricultural and rural development project may have positive economic effects, yet still cause serious environmental damage. This research explores some of the environmental effects of land consolidation, particularly from the perspective of sustainable consumption inputs.

Hasni Moghadam's (2002) study of the socioeconomic effects of rice-land consolidation in Iran found that fragmented land distribution caused social conflicts between farmers and poor use of inputs, land, water, labor and machinery in paddy fields.

Alizadeh et al. (2000) compared the economic effects of traditional and mechanized rice transplantation in Iranian paddy fields, finding that mechanized transplanting reduced the amount of work, improved cultivation conditions and crop yield and reduced production costs and the consumption of seed, fertilizer and other agricultural inputs.

Wadud and White (2000) studied farm household efficiency in Bangladesh, finding that land consolidation increased the efficiency of rice production. In contrast, Sundqvist and Anderson, in their (2007) study of the impacts of land fragmentation on agricultural productivity in Northern Vietnam, found that land fragmentation seems to be positively correlated to productivity due to greater use of fertilizers and greater labour input. Productivity increases in communes that have consolidated their land seems to be explained by initial differences in productivity.

Hristov (2009) assessed the impact of highly fragmented land on farms' productivity and profitability, focusing on Macedonian vegetable growers. Hristov found that consolidated land parcels have higher market values, which encourage the land market. Irrigation and/or drainage systems may be adjusted to the new plots and parcel outline. Furthermore, some actions may be taken into consideration for flood protection and transformation of water bodies and sources, soil conservation and control of erosion. Moreover, land consolidation is likely to promote farmers' understanding of cooperation and willingness to actually cooperate as they realize that cooperation has advantages for all parties involved. The findings of Hristov's regression estimations supported the negative and statistically significant impact of land fragmentation on productivity and profitability of vegetables grown in the research area. However, it should be noted that the consolidation process “can interrupt the crop cycle for several years, and disrupts the ecological benefits of land fragmentation”[14].

## 2. Objectives

The main objective of this paper is to identify the comparison of farming inputs consumption in traditional and developed paddy fields in Iran, based on a case study of Gilan province. This study will asked to answer this question: Whether the land consolidation projects in the paddy fields to reduce the consumption of inputs, especially chemical inputs in Iranian paddy fields؟

## 3. Materials and Methods

This study was carried out by the survey method. The data was collected from 176 rice farmers working traditional fields and 188 rice farmers participating in a farm- development program in Gilan province. These populations were selected using stratified random sampling. The questionnaire-by-interview method was used for data collection. The reliability of the questionnaire was determined by calculating a Cronbach's alpha coefficient (alpha > 0.75) for different sections after conducting a pilot study. SPSS software was used for the data analysis.

The sustainability index for each position use of inputs such as chemical fertilizers was investigated. Consumption of chemical fertilizers depends on crop nutrient needs based on soil type and lack of macro and micro elements. Table 1 lists the amount of several fertilizers generally applied to rice fields.

Table 2 shows the amounts of several types of chemical toxins generally applied to rice fields.

This study compared the amounts of fertilizer and toxins reported by survey respondents with the amounts listed in Tables 1 and 2.

**Table 1.** Amount of Fertilizer Applied to Rice Fields

| Fertilizer type | Amount applied to rice fields (kg/ha) |
|---|---|
| Urea | 120 |
| Phosphate | 50 |
| Potash | 100 |
| Full macro | 300 |

(Rice Research Institute of Iran, 2010)

**Table 2.** Amount of Toxins Applied to Rice Fields

| Type of toxin | Amount applied to rice fields (kg/ha) |
|---|---|
| Herbicides | 3 |
| Insecticides | 1.5 |
| Fungicides | 1 |
| Total | 5.5 |

(Rice Research Institute of Iran, 2010)

# 4. Results

The results showed that in traditional paddies, seed consumption averaged approximately 120 kg of seed per hectare, 7.6 kg/ha more than developed land (Table 3).

**Table 3.** Seed Consumption by Paddy

| Paddy type | Seed consumption(average kg/ha) |
|---|---|
| Traditional | 120.4 |
| Developed | 112.8 |

Farmers of developed paddies used an average of 363 kg/ha of chemical fertilizers, 55 kg/ha per more than farmers of traditional paddies (Table 4).

**Table 4.** Chemical Fertilizer Consumption by Paddy

| Type of paddy | Fertilizer type | Amount of chemical fertilizer used (average kg/ha) |
|---|---|---|
| Traditional | Urea | 150 |
| | Phosphate | 77 |
| | Potash | 83 |
| | Full macro | 8 |
| | Total | 308 |
| Developed | Urea | 176 |
| | Phosphate | 92 |
| | Potash | 83 |
| | Full macro | 12 |
| | Total | 363 |

Farmers of developed paddies used an average of 6.4 kg/ha of toxins, 1.9 kg/ha less than farmers of traditional paddies (Table 5).

**Table 5.** Chemical Toxin Consumption by Paddy

| Paddy type | Toxins type | Amount of chemical toxins used (average kg/ha) |
|---|---|---|
| Traditional | Herbicides | 4.1 |
| | Insecticides | 0.6 |
| | Fungicides | 3.6 |
| | Total | 8.3 |
| Developed | Herbicides | 2.2 |
| | Insecticides | 0.8 |
| | Fungicides | 4.4 |
| | Total | 6.4 |

Farmers of developed paddies used an average of 726 kg/ha of cow manure, 308 kg/ha more than farmers of traditional paddies (Table 6).

**Table 6.** Cow Manure Consumption by Paddy

| Paddy type | Consumption of cow manure (average kg/ha) |
|---|---|
| Traditional | 418 |
| Developed | 726 |

The use of biological pest control was slightly greater on developed paddies than on traditional paddies, although if all three stages of use are considered together, the rates for both paddy types were nearly identical, at 29 percent (Table 7).

There was no significant difference between the two groups (farmers of traditional and developed paddies) in their use of biological pest control and their seed consumption. However, their use of manure, chemical fertilizers and chemical toxins were significantly different at the 99 percent level (Table 8).

**Table 7.** Use of Biological Pest Control by Paddy

| Stage(s) used | Traditional paddy lands | | Developed paddy lands | |
|---|---|---|---|---|
| | Frequency | Percent | Frequency | Percent |
| Non-use | 75 | 42.6 | 70 | 37.2 |
| One stage | 18 | 10.2 | 21 | 11.2 |
| Two stages | 32 | 18.2 | 42 | 22.3 |
| Three stages | 51 | 29 | 55 | 29.3 |
| Sum | 176 | 100 | 186 | 100 |

**Table 8.** Mean Comparison of Farmers of Traditional and Developed Paddy Fields

| Variables | Mean in Groups | t | sig |
|---|---|---|---|
| Chemical fertilizer usage | traditional paddy-field farmers=8.3 developed paddy-field farmers=6.4 | 16.96** | 0.000 |
| Seed consumption | traditional paddy-field farmers=112.8 developed paddy-field farmers=120.4 | $0.100^{ns}$ | 0.752 |
| Chemical toxin usage | traditional paddy-field farmers=308 developed paddy-field farmers=363 | 19.05** | 0.000 |
| Biological pest control usage | traditional paddy-field farmers=1.34 developed paddy-field farmers=1.43 | $0.669^{ns}$ | 0.414 |
| Cow manure usage | traditional paddy-field farmers=418 developed paddy-field farmers=726 | 7.518** | 0.006 |

*Significant at 0.95 level
** Significant at 0.99 level

# 5. Discussion and Conclusions

The results of this research showed that farmers of developed paddy lands used significantly more chemical toxins and manure, and significantly less chemical fertilizer, than farmers of traditional paddy lands. (The It should be noted that in Gilan province, where the surveyed farmers had their lands, a high volume of soil had recently been displaced in the process of roads-making for the plan, which could have affected the results).Because most fertile farm land is used for roads-making in farm development plan. Therefore the farmers need to use the more chemical fertilizer in this rice fields.

The difference between the two groups in their use of biological pest control and their seed consumption was not significant. Thus it can be concluded that the farm development plan didn't reduce the seed consumption and didn't develop the biological pest control in rice fields. The fact that farmers of developed paddies use more manure than those of traditional paddies creates better access for the transportation of farm inputs. Higher levels of chemical pesticides and other toxins for farmers of traditional paddy fields may be due to the lack of mechanized equipment suitable for more efficiently applying better pesticides, and to the presence on traditionally farmed lands of trees and other plants that can harbor pests. These results could be due to the fact that farmers of developed paddies may be familiar with and willing to implement better management techniques and initiatives to improve sustainability. The results agree with those of such researchers as Kopeva (2002) Sundqvist and Anderson (2007), Kunimitsu, Nakata and Toshima (2005) and Alizadeh et al. (2000) concerning the reduction of chemical toxicity and the consequent lessening of negative environmental impact for the use the chemical inputs in rice fields.

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