Chapter 7
Environmental Outcomes

The current system of industrial agriculture has put significant stress on the environment through its use of large scale monocultures in an input-intensive approach. Sustainable agriculture, on the other hand, is not only more likely to be focused on local markets, eliminating the generation of needless greenhouse gases, it has also been seen to increase agro-diversity, support healthy soils and clean water, and contribute to long-term environmental stewardship (see for example, Jianbo 2006; Pretty and Hine 2001; Reidsma et al 2006). The farmer-led approach used in this study supports the development of diverse local agricultural systems based on a range of place-based farmer knowledge.

This chapter is organised around three major issues associated with a conventional, high-input based agriculture. The issue of climate change is discussed in the following chapter. These problems are:

On-farm biodiversity

Conventional agricultural production is focused on very few, high yielding crops. Within crop species, fewer varieties are being used and thousands of old landraces are getting lost. This greatly reduces biodiversity.

Fertiliser use

Fertiliser production consumes huge amounts of fossil fuels. High application rates lead to soil acidification, high leaching losses and nitrate contamination of water, streams and ground water reserves.

Pesticide use

Pesticides endanger farmers during application. Many beneficial insects are killed and resistances to chemicals build up quickly. Water is contaminated and residues accumulate in the food chain posing a serious health risk.

The results show a profound environmental contribution from the farmers involved in sustainable agriculture. The elimination of chemical fertilisers and pesticides and better soil management techniques lead to improved on-farm biodiversity and increased soil fertility. The integrated nature of benefits is underscored by the following comment from a farmer at the Mindanao workshop:

> MASIPAG farmers are different from other farmers because they are free to choose their technologies and are able to implement these in their farms, from the choice of seeds, enriching soil fertility to managing pests and diseases of their crops and livestock. In the MASIPAG farmers is the desire to discover and find other methods for the farm and to gradually restore the culture of cooperation.

On-farm diversity

The on-farm diversity of the organic farms in the study is much higher than for conventional farms. The full organic farmers have a higher diversity of rice varieties, crops, and livestock. Farmers grow and use on average 45 different kinds of crops compared to 30 for the conventional farmers. The organic farmers thus grow 50% more crops on average than conventional farmers (see also chapter two for a discussion of diversification in relation to food security).

The study also looked at the number of varieties of rice grown on each farm. The results indicate a significantly higher number of rice varieties in the full organic group. Nationally, on average, organic farmers grow three times as many rice varieties than

Figure 7.1: Key findings

Full organic farmers have:

- **Increased on-farm diversity**
  Organic farmers grow on average 50% more crop types and three times more varieties of rice than the conventional farmers
- **Decreased chemical fertiliser and pesticide use**
  Organic farmers have eliminated the use of chemical fertilisers and pesticides and use a variety of organic methods. In contrast 85% of conventional farmers use fertiliser and 80% continue to use pesticides.
  97% of the full organic group use alternative pest management.
- **Increased soil fertility, biodiversity and crop tolerance**
  84% of organic farmers but just 3% of conventional farmers report increases in soil fertility.
  59% of organic farmers but just 6% of conventional farmers report a reduction in soil erosion.
  Increased tolerance of plant varieties to pests and diseases is reported by 81% of organic farmers. In contrast, 41% of conventional farmers see the tolerance to pests worsening

conventional farmers. In Luzon, the full organic farmers cultivate, on average, 6.5 varieties, in the Visayas, 5.1 and in Mindanao, 3.1. In comparison, conventional farmers in all three regions grow 1.5 to 1.8 varieties. This reflects a significant contribution to agrodiversity.

On-farm diversity increases are augmented by the emphasis on locally-adapted agricultural systems and diversity increases across the whole network. As a network, MASIPAG has been responsible for conserving and breeding thousands of rice varieties. MASIPAG has collected 1,090 traditional rice varieties. From its participatory rice breeding activities, the network has also developed 1,069 varieties of rice that are locally adapted to specific agroecological conditions and performed 273 crosses resulting in 185 farmer-bred selections.

Figure 7.2: Diversification of rice varieties

No. of rice varieties		Full organic farmers	Conversion farmers	Conventional farmers
National average		4.8***	2.0***	1.6***
By area	Mindanao average	3.1***	2.4***	1.5***
	Visayas average	5.1***	2.0***	1.8***
	Luzon average	6.5***	1.6***	1.6***

On-farm diversity has repercussions for food security, health and increased resilience of farming systems to climatic variation. This is highlighted in the following comment by Ka Pecs, a long-time breeder, farmer-trainer and researcher:

> Many farmers of course are also getting conscious about the need for nutritious food. So they would not depend only on rice or corn, but they have to get more protein from other plants, from animals, so they can integrate. And some come to the inclusion of herbal plants in farmers' fields. They can almost be sure they have something to turn to in cases where they feel some ills from excessive chemical use. So that integration will surely improve the diversity of the farm. Many are also conscious that biodiverse farming is more productive. We supply a better source of income that is more stable, more secure.

Fertiliser use

The farmers using farmer-led sustainable agriculture show a dramatic drop in the use of chemical fertilisers. This is a major environmental contribution. For the full organic farmers, the number of farmers using chemical fertilisers has dropped to zero. In the year 2000, 52% of the farmers now in the organic group were using chemical fertilisers. In contrast, the number of farmers using chemical fertilisers in the reference group remains constant at 85%. In the conversion group, the majority of farmers still use fertiliser, but a reduction is visible from 75% down to 64%.

In terms of the average amount of fertiliser used per hectare of rice, similar trends were recorded. The full organic farmers have fully stopped application of chemical fertiliser so the rate of use has dropped to zero. The conversion farmers have reduced their

Figure 7.3: Use of chemical fertiliser

		Full organic farmers		Conversion farmers		Conventional farmers	
		2007	2000	2007	2000	2007	2000
National average		0	52%	75%	64%	85%	85%
By area	Mindanao average	0	39%	56%	68%	75%	76%
	Visayas average	0	30%	60%	69%	92%	92%
	Luzon average	0	86%	76%	89%	92%	92%

application rate from 3.9 to 2.9 bags (or 195 to 145 kgs), while conventional farmers remain constant at 4.4 bags (220 kgs) per hectare. At first sight these application rates appear moderate. However, it needs to be noted that in general 2-3 harvests per year are possible. Thus, the annual fertiliser input per hectare is much higher. Furthermore, application rates vary strongly. This is shown in the high standard deviation of 4.7 bags (235 kgs). A good proportion of farmers use more than 8 bags (400 kgs) per season. In a specific study on hybrid corn in the Visayas, MASIPAG (2008) revealed that farmers are using in the range of 10-15 bags (500-750 kgs) of chemical fertilisers.

The reduction of chemical fertilisers through the use of farmer-led sustainable agriculture amounts to a very substantial impact on the environment. It reduces environmental damage, water and air pollution, reduces capital costs to the farmer and saves imports. It also has significantly lower impacts on the climate (see chapter eight).

The farmers in the study replace chemical fertilisers with a combination of practices. For example, farmers use animal manure, agroforestry, green manure, azolla, rice straw recycling and bio-rganic fertiliser application. The findings show that the use of rice straw is already well advanced in all regions, while green manure and bio-organic fertiliser is highest in Luzon.

The use of some practices is highlighted in the following table. It shows that the farmers using farmer-led sustainable agriculture apply these practices on a much wider scale than the reference group of conventional farmers.

Figure 7.4: Alternative fertilisation practices

	Full organic farmers		Conversion farmers		Conventional farmers	
	2007	2000	2007	2000	2007	2000
Rice straw	88%	38%	81%	30%	38%	26%
Green manure	46%	18%	37%	13%	7%	4%
Bio-organic fertiliser	37%	14%	33%	13%	6%	7%

Pesticide and herbicide use

The reduction in pesticide use is another important contribution of sustainable agriculture. Excessive pesticide use creates major environmental and health problems. Soils and water is poisoned, beneficial insects are killed and other animals such as fish, crabs and edible snails are negatively affected. Health risks, too, are substantial, particularly for farmers applying the pesticides without appropriate equipment.

The full organic farmers in the study no longer use any pesticides. This is down from a 45% use rate in 2000. In the conversion group, use of chemical pesticide dropped from 61% in 2000 to 16% in 2007. In the reference group 80% continue to use pesticides.

In place of chemical pesticide use, farmers using sustainable practices employ alternative pest management (APM). Three principles applied in APM are:

1. Rely on the natural ecological balance by redesigning the agro ecosystem
2. Deny pests favourable conditions
3. Work with nature's controls not against them.

The study found that 97% of the full organic group are using APM practices. The conversion group applies APM in 61% of cases while only 7% of conventional farmers use these methods.

In conventional farming, herbicide is increasingly used to control weeds. MASIPAG has introduced various alternative methods of weed control. Hand weeding is common practice among the MASIPAG farmers (93% of full organic farmers, 84% of conversion

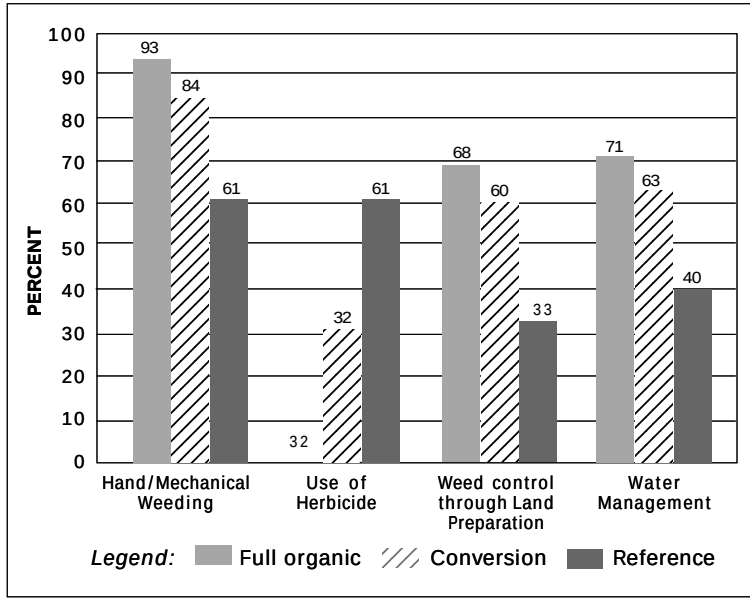
Figure 7.5: Methods for the control of pests

	Full organic farmers		Conversion farmers		Conventional farmers	
	2007	2000	2007	2000	2007	2000
Alternative pest management APM	97%	44%	61%	23%	7%	4%
Chemical pesticides	0	44%	16%	61%	80%	84%
Combination	0	1%	15%	5%	6%	4%
No Answer	3%	12%	9%	11%	8%	9%

Data was not recorded for Visayas so avarage is based on Luzon and Mindanao only

farmers), while only 61% of the conventional farmers employ the technique. The full organic farmers do not use herbicides at all, while 32% of the conversion farmers use some herbicide. Other methods of weed control such as land preparation and water management are almost twice as frequent in the full organic group compared to the reference group. The following figure shows the status of different techniques. In times of climate change, droughts

Figure 7.6: Comparison of weed control practices

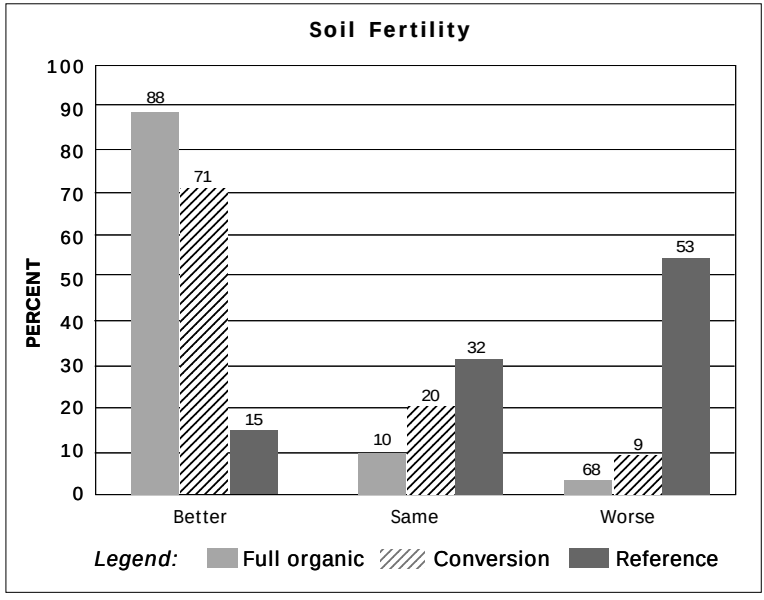


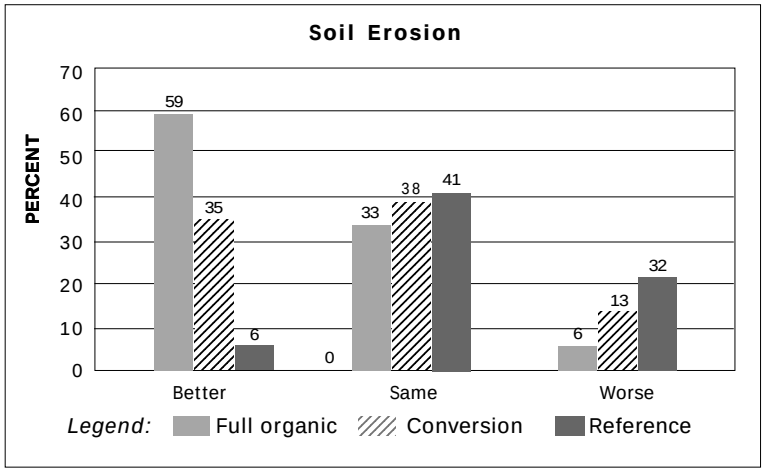
will become more frequent, and thus the improved water management techniques can be seen as an asset beyond weed control for the future.

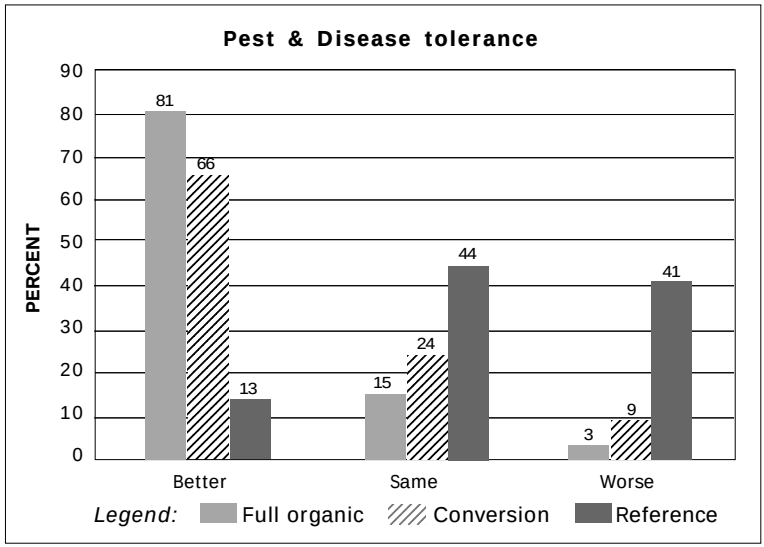
Gabriel Diaz conceptualises this approach as one of trust in the environment. He says:

> We changed our practice - with the seeds, practiced the trial farm and used the verification trials. I became to believe in MASIPAG as the real organic. All plants can grow. Everywhere I went I collect varieties because I know they can grow without chemical intervention. Other farmers' minds are limited because they believe plants need chemicals. So it limits their thinking. From that time up until now, it has become my way of life to plant everything. I think that this is why the chemical farmers don't have as many crops, because of the limitations presented by the chemicals. They think that if a plant doesn't have chemicals, it doesn't grow. They don't trust nature anymore. They are dependent on chemicals.

Figure 7.7: Perceived changes of soil fertility, soil erosion and pest tolerance







Soil fertility, biodiversity and crop tolerance

In the survey, farmers were also asked if they observed any changes on their farms relating to soil fertility, soil erosion and the tolerance of crops to pest and diseases. This question reveals strong differences between the farming systems. The results are depicted in the figure 7.7.

Farmers involved in farmer-led sustainable agriculture observe major increases in soil fertility. In total, 84% of the full organic farmers and 71% of farmers in conversion report increases in soil fertility. In sharp contrast, only 3% of conventional farmers report improved soil fertility while 53% judge it to be worse.

Soil erosion results reveal similar trends. Of the full organic farmers, 59% observe a reduction in soil erosion, while only 6 % of the conventional farmers report such benefits.

Tolerance of plants towards pests and diseases is also strengthened through the organic system. Of the organic farmers, 81% report an improvement in the tolerance of plants while in the reference group only 13% recognise an improvement and 41% see the tolerance to pests worsening. All differences in perception relating to improvements in soil fertility, reduced soil erosion and plant tolerance are very highly statistically significant.

A reduced application of pesticides and higher diversity of crops should also improve biodiversity of fauna. To validate this question, the households were asked if they had seen any changes in biodiversity in the last 7 years. The results show a marked impact. Among full organic farmers, 88 % estimate an increase in biodiversity, while only 20% of conventional farmers identify the same trend. On the contrary, in the reference group of conventional farmers, 57% observe a decrease in biodiversity, while 22% of the MASIPAG farmers report this trend.

The farmers involved in the study have clearly made impressive progress across a range of environmental indicators. The findings have significant flow-on effects as they contribute to a range of

Figure 7.8: Farmer's perception of changes in biodeversity

Perceived changes in Biodiversity	Full organic farmers	Conversion farmers	Conventional farmers
No change	12	19	20
Increased	66	52	22
Decreased	22	29	57

public goods like clean air and clean water, and support the development of diverse and resilient systems. Increasing diversity and tolerance of crops to pests and disease are excellent strategies to deal with new stresses arising from climate change while the promotion of locally specific agricultural systems will increase agro-diversity, not just on-farm, but nationally, as different varieties are developed to suit different environmental conditions.