

THE IMPACT OF NO-TILL IN GHANA

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1. Introduction

Increasing pressure on natural resources in Ghana are causing severe land degradation. In order to foster the shift from slash and burn to no-till (NT) with mulch, Monsanto, Sasakawa Global 2000 (SG 2000) and the Crops Research Institute (CRI) teamed up in 1993 to organize a participatory research and extension program that is having a tremendous impact on small farmers.

We studied the impact of NT on farmers who are using this technology. The reasons for non-adoption were also studied, even though with less detail. The sample had three categories of farmers – those using NT (users), those who had used it and subsequently abandoned it (abandoned), and those who had never used it (never used).

Due to budget constraints the sample was directed to users, thus, the extent of adoption was not estimated. Additionally, since it is not known whether the sample is representative of the population, the inferences are valid only for the sample. In the absence of baseline data, it was not possible to obtain precise estimates of the impact of NT. However, based on farmers' qualitative assessments we estimated some of the benefits of NT, such as reductions in labor requirements for different agricultural tasks.

A total of 30 villages where NT has been demonstrated were randomly chosen from the Ashanti, Brong Ahafo and the Northern regions of Ghana. In each selected village, 3-4 farmers (depending on the number of NT users) were randomly picked from a list of farmers who were using NT. In total, 91 users of NT were interviewed. It was not possible to prepare a similar list of farmers who had used NT and then abandoned it, because almost all farmers who tried it, never returned to conventional tillage. Consequently, only 18 farmers who abandoned could be identified. It was also not possible to compile a list of farmers who had never used NT. Therefore, 1 or 2 houses (depending on the size of the village) in each village were

selected randomly. If the farmers in the house fell into this category, they were interviewed; 37 farmers who had never used NT were interviewed. Thus, the total sample size was 146.

2. General comments about users of NT technology

Most users (84%) practice continuous NT, the recommended practice to reap the long-term economic and environmental benefits. Most farmers have used NT uninterruptedly for 3 to 6 years, with a maximum of 10 years. NT is practiced in both the major and the minor seasons by 75% of users and 9% have naturally one cropping season. Only 16% of farmers use NT just once out of the two seasons they have.

The percentage of users who do not use NT on all their land is 43%. Out of this, 11% mentioned that NT is not good for some crops, reflecting the fact that research on NT has concentrated mostly on maize and cowpea. Twenty-two percent of the farmers also mentioned money restrictions to the expansion of NT.

The NT package developed in Ghana represented a relatively small change from conventional agricultural practices. This explains why 65% of users reported that it was not difficult to command the NT package, with 77% of users realizing the benefits of NT in the first season and 94% within 2 seasons. Users were asked their opinion about problems associated with NT. Learning something totally different from what they used to do was mentioned by 88% of users; however, only 31% of this group mentioned that learning the package was difficult. This indicates a divergence between the a-priori perception of the difficulty of NT and the actual degree of complexity, *which can be reduced with information programs*.

It has been argued that small farmers spend more money in commercial inputs with NT than with slash and burn. However, only 33% of users mentioned this as a problem.

Innovative abilities are found in only a minority of individuals, and Ghanaian farmers are no exception: 10% of the users admitted modifying the recommended package. All of them tried to reduce the dosage of the herbicide. Tapping this source of information is crucial to a wider and faster dissemination of NT.

3. Agricultural practices

More than 80% of users follow the recommended NT package. Glyphosate for pre-planting weed control is used by 75% of users, 5% do manual control and 16% use alaclor+atrazine, indicating a lack of knowledge about herbicide use. Manual weed control for post-planting is used by 44% of the farmers while 39% use atrazine or alaclor+atrazine (Table 1). The proportion using just atrazine is slightly higher than that of alaclor+atrazine. If weeds are sparse, farmers can control weeds only once using glyphosate or glyphosate+alaclor+atrazine or atrazine immediately after planting; this practice was used by 12% of users.

Table 1: Pre- and post-planting weed control methods of NT farmers

Method	% of farmers using method	
	Pre-planting	Post-planting
Glyphosate	75	9
Alaclor+Atrazine	16	18
Manual	5	44
Slash/burn	3	0
Mechanically with tractor	1	1
Atrazine	0	21
Paraquat	0	4
Glyphosate + Alaclor+Atrazine	0	3

Most farmers (70%) use a smaller dose of glyphosate than that recommended by researchers (3 liters/ha). A large proportion of farmers use 1.8 liters/ha (23%) and 2.5 liters/ha (24%). The fact that most farmers use less herbicide than the recommended dose may be explained by the fact that weed control becomes easier the longer NT is used. Then, the dose actually needed by farmers that had been using NT for a few years may be lower than the recommended one. Further research on this topic is needed.

The most important weeds are grasses as 86% of the farmers controlled them. Even though broad-leaf weeds are present, they are not a major problem; only 14% of the farmers reported controlling them.

Most farmers follow other recommended NT practices. For example, most farmers spray at the recommended weed height of not more than 40 cm (87%), use a clean water source (87%) and use the recommended spraying techniques (80%). Most farmers allowed weeds to grow to between 30 and 40 cm and then controlled with glyphosate; the recommended dose is 3 liter/ha, but if more aggressive weeds, like *Imperata cylindrica*, are present, higher doses are required. Weed control with NT was actually easier for 70% of users. There is no increase in the pest pressure in terms of population and species. Actually, 57% of users find pest control easier under NT.

Eighty percent of the farmers have the soil adequately covered at planting but 37% do not have an adequate cover at flowering because the residue decomposes too fast. Some farmers (45%) add some type of organic matter. The problems caused by the rapid decomposition of residues could be solved by adequate research to identify acceptable rotations or new plant varieties that decompose less rapidly.

The biggest agricultural problems faced by users are planting (28%) and plant survival (24%). These could be reduced with adequate planting equipment.

Most users (78%) did not change the crops they used to plant with the adoption of NT. Only 30% of the farmers use rotations. The low percentage of farmers rotating crops again stresses the need for more research and extension on rotations.

4. Farmers who tried NT and later abandoned it

Farmers in the sample who tried NT and then abandoned used it, on average, for 3.1 years. One third of them used it for four years or more before abandoning, while only 17% abandoned in the first year.

Problems to access adequate contract planting (not available on time or too expensive) was the main reason for reverting to slash and burn for 56% of the farmers in this group, 6% mentioned that the soil was too compact and 23% had problems with understanding the package (could not control weeds, inadequate advice or required additional work). These reasons reinforce the previous finding that planting is the major technical problem faced today by Ghanaian farmers willing to use NT in.

When directly asked what they would require to use NT again, 78% mentioned financial support and 22% cheaper herbicides. But when asked why they used NT occasionally, only 5 out of 18 (28%) mentioned lack of money as a problem. The rest mentioned technical problems. As seen earlier, financing seems to be a problem for about 25% of the farmers.

Access to technical advice is not a problem for 83% of these farmers. Seventy-seven percent of the abandoned farmers could have access to researchers or extension agents and 11% to other farmers.

5. Farmers who never used NT technologies

More than half (56%) of the farmers who never used NT knew about the technology. Less than half of farmers in this group (41%) heard about the technology from other farmers. Only 8% heard of it from a researcher or extension agent; also, only one farmer mentioned going to a field day. By comparison, 72% of users heard about NT from a researcher or extension agent.

The main reasons mentioned by these farmers for not using NT are economic: either that the herbicide is too expensive or that more cash is required compared with the practices presently used. About 30% of the farmers mentioned difficulties in contracting planting or spraying. This reason was also important for the abandoned farmers. The complexity of the technology and the lack of access to technical advice are important for about 33% of respondents in the category. This strengthens the idea that these farmers are less innovative than the other groups. The fact that technical issues are not ranked as very important reflects lack of command of the technology.

Seventy-six percent of the farmers that never used NT had visited users and 73% had access to technical advice. Exposure to the technology is therefore not a problem.

6. Impacts of NT

The most important impact of NT on small-scale farmers is the reduction in the amount of labor per unit of agricultural output. Farmers used this extra time to undertake other activities while still producing at least

the same amount of food as before adopting NT. These activities resulted in higher income and higher standards of living.

6.1. Labor savings

The reduction in male family labor working in the fields after adopting NT was 31%; the reductions in female and child family labor were not statistically significant (Table 2). The reason for the difference in male and other labor savings is that NT simplified tasks that are usually reserved for men: land preparation, planting and chemical weed control.

Table 2: Average number of family members who work in NT fields

Activity	Adult males	Adult females	Children	Total
Before adopting NT	3.6	1.8	1.9	7.3
After adopting NT	2.5	1.6	1.6	5.3
Difference (%)	31	11	16	27
Significance	Sig.	not sig.	not sig.	

No till reduced labor requirements for land preparation and planting by 22%. The labor requirement for in-crop weed control fell by 51% from an average of 8.8 man-days/ha to 4.3 man-days/ha as shown in Table 3. There was a slight increase in the labor requirement for harvest from 7.6 man-days /ha to 8.6 man-days /ha as a consequence of the higher yields obtained under NT.

Table 3: Average man-days per hectare required for selected farming activities

Activity	Farming activities (man-days/ha)			
	Land preparation and planting	Weeding (in-crop)	Harvesting	Total
Before adopting NT	9.4	8.8	7.6	25.8
After adopting NT	7.3	4.3	8.6	20.2
Difference (%)	22	51	-13	22
Significance	sig.	sig.	sig.	sig.

Work should not be measured only in hours but in the effort demanded to achieve a particular task. A smaller effort increases the ability to start new activities and results in a higher quality of life. Ninety nine percent of users agreed that agricultural work with NT is less physically demanding; the same percentage agreed that it reduces labor requirements in critical moments, thus simplifying labor management.

6.2. Impact on agricultural practices

Farmers were asked to mention the three most important changes that NT had brought to their farming activities (Table 4). This question was open, i.e., farmers gave their choices without inducement from the interviewer. The majority of farmers mentioned that NT has reduced the investment in cash and labor and resulted in higher yields. Other important impacts were easier weed control and saved time for farmers. Less frequently mentioned changes are expansion of farm and improved soil fertility.

Table 4: Most important changes that NT brought to farming activities

Change	% of farmers that mentioned this effect*
Good crop growth	15
Less cash and labor investment	69
Easier weed control	41
Time saving	32
More income	19
Higher yields	62
More crops grown	7
New or expanded farm	18
Increased soil fertility	18
New knowledge	4
Stopped burning farm	6
Increased interest in farming	5
Now plant in lines	5

* Total percentage is more than 100% because of multiple answers

In a different set of questions farmers were asked whether they agreed or disagreed with a list of statements about NT as presented in Table 5.

Table 5: Farmers' responses to a series of statements about their farming activities

I agree with the following statement (% of users)	
Allows to expand the planted area	94
In bad years, I still get something	84
Reduces soil erosion	87
Improves soil water availability for the plant	99
Reduces the need to use fertilizer	87
Improves soil structure	89
Reduces time between harvest and planting next crop	80
Facilitates weed control	96
Facilitates pests control	97
Yields are less affected by late or early planting	80
Increases yields	99
Reduces production costs	97

The majority of farmers (between 84% and 99%) agreed that NT increased production, reduced costs, reduced the risk in bad years and facilitated agricultural production. In particular, 67% of the users reported a change in the weed and pest species after the adoption of NT and 70% of the farmers found controlling the new weeds easier. Pest control was also reported to be easier for 57% of the users.

Normal maize yields of users of NT were 16% higher than those of farmers who abandoned and 45% higher than yields of farmers who never used. The yield differences in 2000, a dry season, were 38% and 48% respectively. This means that the yield reduction caused by drought was 24% for users, 36% for abandoned and 30% for farmers who never used. In other words, NT reduced the water stress of maize plants. Three risk factors are reduced with NT: the covered soil increases water availability in dry years, the reduced turn-around time permits planting of the second crop closer to the optimal date and the presence

of a larger number of beneficial insects facilitates pest control. When asked if they still get something in bad years, 84% of users responded affirmatively. Reduction of the downside risk is especially important for small farmers that have little savings to weather a bad harvest.

Sixty nine percent of farmers that use NT and 72% of farmers who abandoned expanded their farming area compared to 30% of farmers who never used it.

6.3. Economic impact on families

As in the previous section, farmers were asked to mention the three most important changes that NT had brought to their families.

Table 6: Impact on family

Change	% of farmers *
Increased income	87
More time for other activities	48
Increased food availability	51
Reduced labor and effort	43
Reduced child labor	5
Financially self-dependent	8
Farm expansion	7
Built house/ acquired building plot	6
Prompt payment of school fees	19
Purchase home appliances	10
Purchase milling machine	3
Improved health	3

* The percentages are more than 100% because of multiple answers.

Most farmers (87%) reported having a higher income (Table 6). Other important changes were increased food availability, more time for other activities and reduced labor and effort. Nineteen percent of farmers mentioned the ability to promptly pay school fees, thus securing their children's education.

Users who reported having new activities were requested to mention them. Eighty three percent of respondents started other income generating activities, mostly other farm activities or trading.

7. Conclusions

The NT package developed in Ghana is essentially a weed control system; issues related to machinery were not researched. This reflected the low input agricultural practices prevalent in the study area: most farmers plant with a cutlass. The relative similarities between conventional practices and NT facilitated adoption. Maintenance of the soil cover was also aided by the and the fact that few farmers have animals.

Although NT has had important impacts on farmers who use it, there is room for other benefits and increased adoption. But these depend on further research to develop the missing components of a full package:

- Planting is the most important technical problem faced by farmers willing to use NT in Ghana. Adequate machinery can improve plant standing, reduce labor requirements for planting for small farmers and also make NT appropriate for mechanized farmers.
- The low percentage of farmers rotating crops poses a potential threat as new weeds and pests may develop in response to the monocropping system.
- Residues decompose too fast leaving the soil without cover during important stages of plant development.
- Learning something totally different from what they used to do was mentioned as a major problem to the use of NT. However, only one-third of users mentioned that learning the package was actually difficult. This difference indicates a divergence between the a-priori perception of the difficulty of the package and the actual degree of complexity and can be reduced with information programs.