CHANGE OF SUGARCANE PRODUCTION AFTER INTRODUCTION OF DE-TRASHING EQUIPMENT: A CASE STUDY OF IZENA ISLAND

By

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KEYWORDS: De-trashing Equipment, Ageing Population, Fertilisation Management.

Abstract

THIS PAPER will discuss the relationships between an ageing population of sugarcane growers on Izena Island, the introduction of mechanical de-trashing procedures, subsequent changes in soil management practices and the implications for continuing productivity. The farming demographic in Okinawa Prefecture, and Izena Island in particular, between 1995 and the present day reveals a decrease in sugarcane production, an average farm size at 1 hectare or less, and the average age of the farmer at 65 years or more. Statistics reveal also that the succession of farm land and farming, as an occupation from one generation to the next, is not an enduring tradition. With their increasing age, sugarcane growers have been more accepting of mechanical procedures that ease the physical burden of their workload but, as this paper reveals, such procedures can sometimes have unexpected consequences. Prior to mechanical intervention, the dead leaves (trash) were removed from the cane stalks before transportation to the mill, and therefore remained on the farm where they were subsequently returned to the soil as organic matter. With the new de-trashing procedures, the trash is removed with the cane stalks to the mill, where it is composted as a by-product of the milling process. Furthermore, where previously each farm retained its own trash for composting, the mechanical processing at the mill has resulted in uneven distribution and supply of composted trash to farmers. This has raised concerns about deteriorating soil fertility, decreasing productivity and inadequate water conservation due to lack of organic material in the soil.

Introduction

Okinawa Prefecture is sub-tropical and consists of large and small islands. Izena Island is a solitary island in the northern part of Okinawa Prefecture. Sugarcane is the main industry on each island and in the economy of Okinawa Prefecture. However, the production of sugarcane in Okinawa Prefecture is decreasing, and the age of growers is on the increase.

According to previous research, there is a causal relationship between the low quantity of production and an accumulation of inadequate cultivation techniques (Fukunaka *et al*., 1999; Kikuchi, 2005). Moreover, implementation of fertilisation management influences the quantity of production (Kikuchi *et al*., 2007). Izena Island introduced de-trashing equipment early in Okinawa Prefecture. While the growers' age was increasing, introduction of de-trashing equipment which can reduce harvest work had a big influence. However, fertilisation management suffered and production decreased. After introducing de-trashing equipment, growers ceased the return of trash to the farm at harvest, which reduced organic matter in the soil and may be responsible for reduced production. The purpose of this paper is to examine how to maintain soil fertility.

Research methods

Investigation was conducted over two years (2004 and 2008), in order to clarify a possible relationship between the use of de-trashing equipment and production trends. In November 2004, 42 households contributed data for the study. Information gathered on each household included the grower's age, the existence (or not) of a successor to the current grower, the types of sugarcane grown, as well as details on the use of irrigation, deep ploughing, and moulding. In August 2008, 26 of the households were re-surveyed.

Results and discussion

The rate of trash, and its relation to unit crop yield

The harvested area in Okinawa Prefecture decreased to 12 485 ha in 2004 (Figure 1). Yield of cane peaked at 84.8 t/ha in 1990 and has now decreased to 60–70 t/ha.

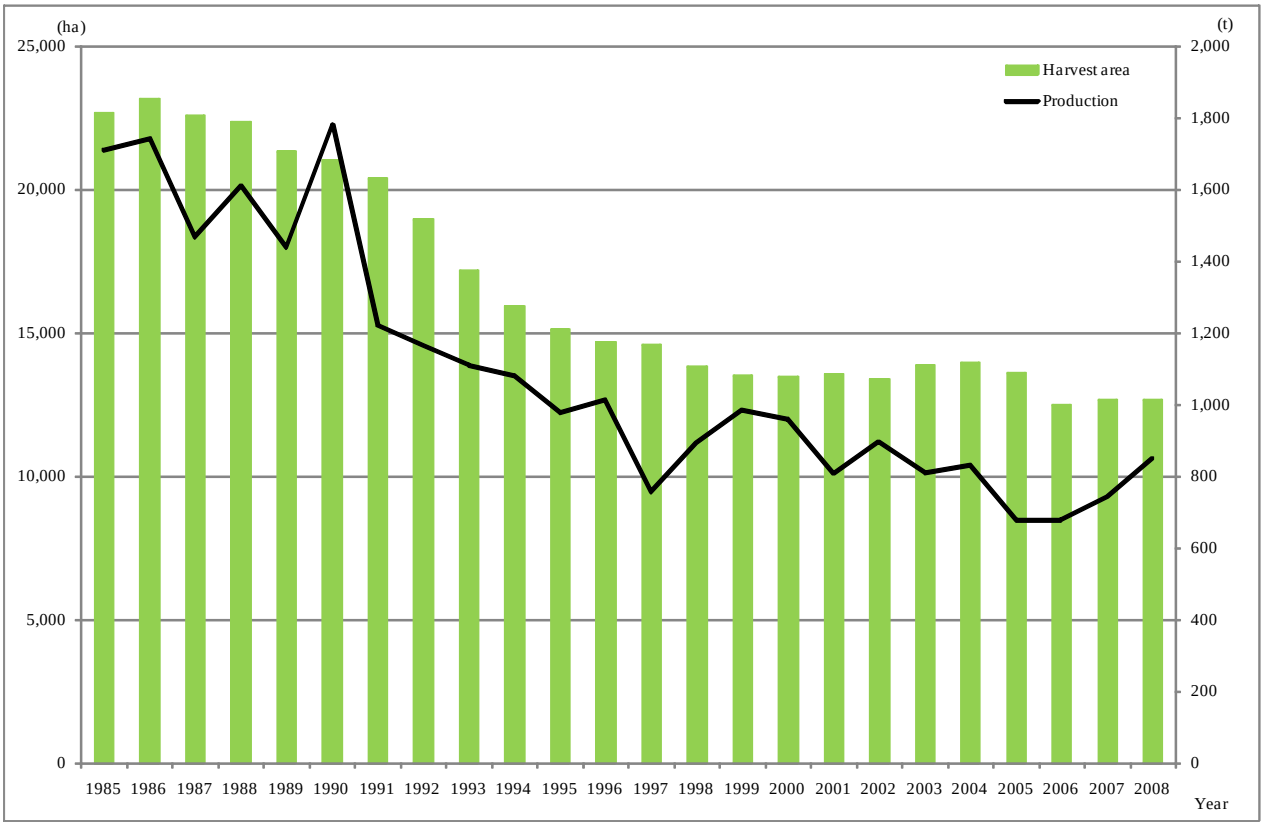

Fig. 1—Harvested area and production of sugarcane. Source: Based on data from the Okinawa Prefecture Division of Agriculture, Forestry and Fisheries (1999).

If an ageing grower does not have a successor, the farmland may be abandoned. However, de-trashing equipment has reduced labour on the farm, so older farmers have continued to farm.

Before 1993, the leaf was peeled off before harvest, and the dead leaf was returned to the farmland. Per unit crop production was around 60 t/ha. However, after 1997, per unit crop production could not maintain 60 t/ha (Figure 2).

After 1993, when de-trashing equipment was introduced, the amount of trash for each 1 ha shows the tendency to increase because it omits the peeling off of the leaf by the grower. Before 1993, an average of 1.5 t/ha of trash was left on the field after harvest.

However, after 1994 when de-trashing equipment was introduced, an average of 6.2 t/ha of trash is returned to farmland but only to specific growers. Average fertility of soil has decreased, and production has decreased.

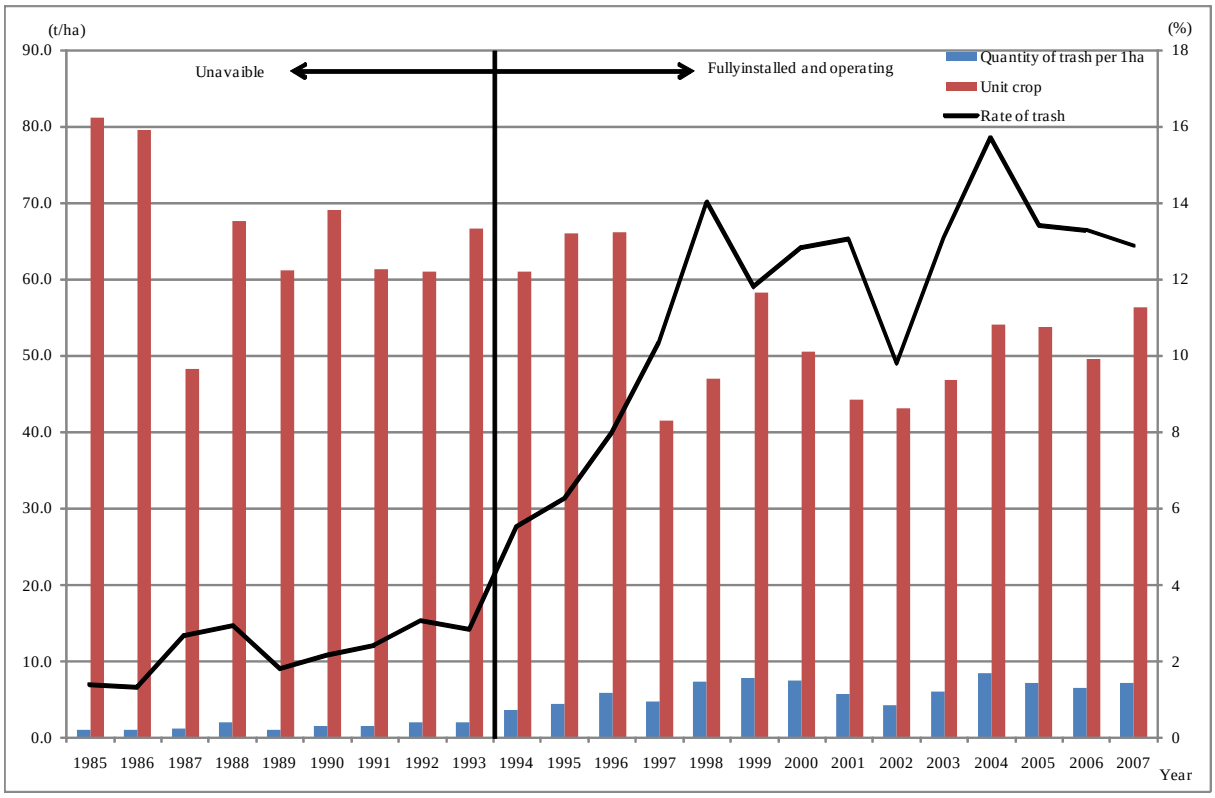

Fig. 2—Rate and quantity of trash produced per ha. Source: Based on data from the Japan Sugar Refiners' Association. Quantity of trash = Yield × Rate of trash/100・・・(1). Quantity of trash per ha = (1)/Crop area × 100.

In Izena village, the de-trashing system is as follows. Cane is cut at the base and the cane top is removed. Cane and tops are picked up by a crane (Figure 3) and transported to the de-trashing equipment. Trash is removed in the de-trashing equipment and is processed in the sugarcane mill. Trash is taken to the compost factory, and is composted. In Izena village, the actual quantity of compost produced is from 3000 to 3500 t/year. The compost is only returned to 23.4% of the farmland.

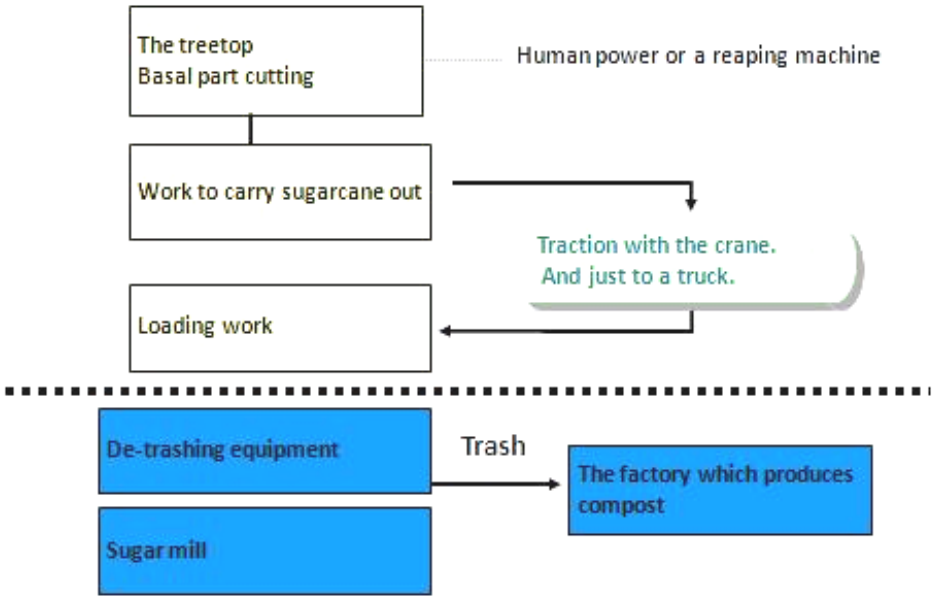

Fig. 3—Intensive de-trashing equipment: The 'Izena Method.'Source: Takufumi Shinohara

Soil fertility must be maintained to maintain production. The compost is indispensable in maintenance of soil fertility. However, in Izena, there is a problem in the source of supply being restricted. Compared with the number of growers, the source of supply of organic matter in the village is restricted. Compost can be supplied to only about 40% of growers. Livestock faeces and urine discharged from dairy cattle in the village are processed in the compost factory. However, because there are few animals in the village, the absolute quantity of organic matter is insufficient.

All stems carried to the mill by truck are fed into the sugar mill through the cane feeder, and proceeds through the sugar mill as indicated by the red arrows (Figure 4). The first stage of trash separation is wind-powered, and the soil and sand is filtered out in the rotational separator. After passing through 3 wind-powered separators, the de-trashed raw material passes onto the clean cane conveyor and is carried into the sugar mill. The wind velocity used in the de-trashing equipment varies according to mill, and it can be adjusted in each de-trashing according to the raw materials.

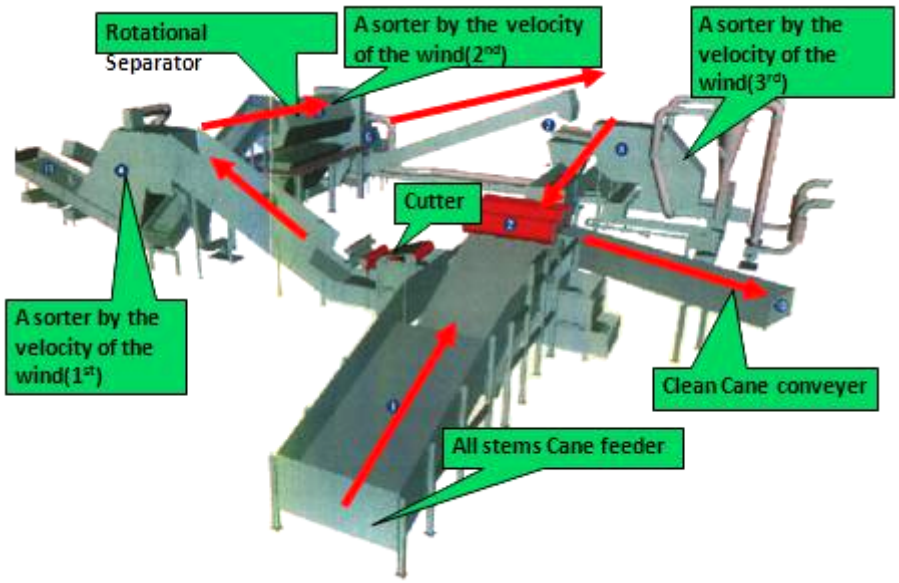

Fig. 4—De-trashing equipment. Produced by Tsukishima Co. Ltd.

Amount of fertiliser applied and unit crop

Growers investigated were 42 households (2004) and 26 households (2008). This paper classified the grower by using the same index for two years (Tables 1 and 2). The full-time growers of sugarcane are farm manager husband and wife. Harvest area is 1 ha or more.

Table 1—Management form standard (2004).

	Correspond-ing grower.	Grower who engages in own agriculture.	Number of grower engaged in own farming.	Harvest area (ha).	Average unit crop (t/ha)	Grower age.	The rate of successor reservation (%)
Full-time grower of the sugar cane	5	Mainly farm operator husband-and-wife	2 or more	1ha or more	58.9	35～55	100.0
Aged full-time grower	18	Mainly farm operator husband-and-wife	2 or more	–	47.3	65 or more	44.4
Part-time grower	13	Only grower	One person.	1ha or more	55.6	45～60	30.8
Petty grower	6	Only grower	One person.	0.9ha or less	43.5	40～64	50.0

Source: From the investigation.

Table 2—Management form standard (2008).

	Corresponding grower	Grower who engages in own agriculture	Number of growers engaged in own farming	Harvest area (ha).	Average unit crop (t/ha)	Grower age	The rate of successor reservation
Full-time cane grower	4	Mainly farm operator husband-and-wife	2 or more	1 ha or more	93.8	Less than 60	50.0
Aged full-time grower	11	Mainly farm operator husband-and-wife	2 or more	–	53.6	65 or more	18.2
Part-time grower	8	Only grower	One person.	1 ha or more	57.5	40～64	50.0
Petty grower	3	Only grower	–	0.9ha or less	54.2	–	0.0

Source: From the investigation.

The age of the full-time farm manager is 60 years or less, and it is a grower who has a successor. The aged full-time grower was classified according to agricultural continuity and an age element. Those who are engaged in agriculture aged 65 and over cannot start work in other industries. It is a grower who is making agriculture a principal occupation.

A part-time farm grower is only a farm manager. Only 30–50% of these growers have a successor, and do not work full-time on the farm. The manager's wife works in other industries and is not engaged in agriculture at all, which reduces the labour force. In addition to agricultural income, the livelihood of the grower is realised by income other than agriculture. A petty grower has a harvested area of 0.9 ha or less, and is engaged in agriculture only as a manager. The manager is also working in other industries. Agricultural income is only a part of gross income.

The full-time grower of the sugarcane should use 30–45 t/ha of organic fertiliser. However, the actual amounts of fertiliser are insufficient (Tables 3 and 4). The grower is compensating this insufficiency with chemical fertiliser. With commercial fertiliser, 500 kg/ha is required, but seems excessive. To increase crop yields, growers used a lot of commercial fertilisers.

Table 3—The actual situation of the main fertilisation management (2004).

	Unit crop(t/ha)	Enforcement rate of molding (%)	Enforcement rate of irrigation (%)	Rate of use of chemical fertiliser (t/ha)	Rate of use of organic fertiliser (t/ha)
Full-time sugar grower	58.9	100.0	60.0	1.7	35.2
Aged full-time grower	47.3	88.9	38.9	2.1	45.2
Part-time grower	55.6	88.5	61.5	2.1	34.0
Petty grower	43.5	100.0	50.0	1.8	23.7

Source: From the investigation.

Table 4—The actual situation of the main fertilisation management (2008).

	Unit crop(t/ha)	Enforcement rate of molding(%)	Enforcement rate of irrigation (%)	Rate of use of chemical fertiliser (t/ha)	Rate of use of organic fertiliser (t/ha)
Full-time cane grower	93.8	75.0	100.0	1.8	12.5
Aged full-time grower	53.6	63.6	63.6	1.2	21.9
Part-time grower	57.5	87.5	75.0	4.9	6.8
Petty grower	54.2	66.7	66.7	1.8	0.0

Source: From the investigation.

The actual condition of unit crop and fertilisation management

The full-time grower of sugarcane compares 2004 with 2008 by unit crop, and most of the improvement is due to irrigation. Because the grower increased irrigation to 60%, per unit crop production became 58.9 t/ha (2004). However, in 2008, irrigation increased to 100% and per unit crop production was 93.8 t/ha. On the other hand, the aged full-time grower had 38.9% irrigation in 2004 and per unit crop production of 47.3 t/ha. However, in 2008, irrigation increased to 63.6% and per unit crop production increased to 53.6 t/ha.

Conclusion

Compared with the investigation in 2004, growers recognised the importance of fertilisation management in 2008. Therefore, crop yields have improved. The introduction of de-trashing equipment has reduced the grower's work burden. The grower can now carry out moulding and irrigation. However, commercial fertiliser is now the main source of fertiliser. Because the amount of compost has decreased, fertility has suffered. Moreover, the dead leaf is not returned to the farmland by introducing de-trashing equipment. Trash generated from de-trashing equipment is added to animal manure at the compost factory. This compost is available to only limited growers. Other growers must use chemical fertilisers. The present unit crop level is based on proper moulding and irrigation. Improving the fertilisation system leads to the possibility of improvement in unit crop. Continued research is necessary to stabilise production.

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CHANGEMENT DANS LA PRODUCTION DE CANNE A SUCRE APRES L'INTRODUCTION D'EQUIPEMENT DE DEPAILLAGE: UNE ETUDE DE CAS DE L'ILE D'IZENA

Par

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MOTS CLES: équipement de dépaillage, Problèmes d'une Population Vieillissante, Gestion de la Fertilisation.

Résumé

CE PAPIER discutera de la relation entre une population vieillissante de planteurs de canne à sucre sur l'ile d'Izena, de l'introduction de procédures de dépaillage mécanique, des changements des pratiques de gestion du sol qui en découlent et des implications pour une productivité continue. La démographie agricole de la Préfecture d'Okinawa et de l'ile d'Izena en particulier, entre 1995 et le

jour présent, révèle une réduction de la production de canne à sucre, une taille moyenne d'exploitation d'un hectare ou moins, et un âge moyen d'agriculteur de 65 ans ou plus. Les statistiques révèlent aussi que la succession de terre agricole et de la culture d'une génération à l'autre n'est pas une tradition durable. Avec leur âge croissant, les planteurs de canne à sucre ont mieux accepté les procédures mécaniques qui réduisent l'aspect ardu de leur tache, mais ces procédures peuvent parfois avoir des conséquences inattendues, comme révélé par ce papier. Avant la mécanisation, la paille était enlevée avant le transport des cannes vers l'usine et restait sur l'exploitation où elle était retournée au sol comme matière organique. Avec la nouvelle procédure de dépaillage, la paille est enlevée à l'usine et compostée comme un sous-produit de l'usinage. De plus, quand précédemment chaque exploitation conservait sa propre paille pour le compostage, la procédure mécanique à l'usine a résulté en une distribution inégale de la paille compostée aux producteurs. Cela a suscité des inquiétudes à propos de la baisse de fertilité du sol, de la diminution de productivité et de la conservation inadéquate d'eau, dues à un manque de matière organique dans le sol.

CAMBIO EN LA PRODUCCION DE CAÑA DE AZUCAR DESPUES DE LA INTRODUCCION DE EQUIPO PARA REMOCION DE HOJAS: ESTUDIO DEL CASO DE LA ISLA DE IZENA

Por

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KEYWORDS: Equipo Deshojador, Problemas de Envejecimien to de la Población, Manejo de la Fertilización.

Resumen

ESTE ARTÍCULO discutirá las relaciones entre el envejecimiento de la población de los productores de caña de azúcar en la isla de Izena, la introducción de procedimientos mecánicos de deshoje, los cambios en las prácticas de manejo del suelo y las consecuencias para la productividad continua. La demografía de los agricultores en la Prefectura de Okinawa, e Isla de Izena en particular, entre 1995 y el día de hoy revela una disminución en la producción de caña de azúcar, un tamaño medio de las explotaciones de 1 hectárea o menos, y edad media del agricultor de 65 años o más. Las estadísticas también revelan que la sucesión de las tierras agrícolas y la agricultura, como ocupación de una generación a la siguiente, no es una tradición perdurable. Con el aumento de la edad, los cultivadores de caña de azúcar tienen más aceptación de los procedimientos mecánicos que alivian la carga física de su trabajo pero, como revela este estudio, tales procedimientos a veces pueden tener consecuencias inesperadas. Antes de la intervención mecánica, las hojas muertas (basura) eran retiradas de las cañas antes de su transporte a la fábrica, por lo que permanecían en la finca donde posteriormente eran devueltas al suelo como materia orgánica. Con los nuevos procedimientos de deshoje, la basura se va a la fábrica junto con la caña, donde es compostada como subproducto del proceso de molienda. Además, anteriormente cada explotación conservaba su propia basura para el compostaje, ahora el tratamiento mecánico en la fábrica se ha traducido en desigual distribución y suministro a los agricultores de la basura compostada. Esto ha suscitado preocupaciones sobre el deterioro de la fertilidad del suelo, disminución de la productividad e inadecuada conservación del agua debido a la falta de materia orgánica en el suelo.