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**Upland Development Programme
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**PROBLEMS WITH CASSAVA
PRODUCTION IN THE UPLANDS
OF SOUTHERN MINDANAO**



Report by

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PROBLEMS WITH CASSAVA PRODUCTION IN THE UPLANDS

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PROBLEMS WITH CASSAVA PRODUCTION IN THE UPLANDS OF SOUTHERN MINDANAO

SUMMARY

Cassava production, even on the gentlest of slopes, causes unacceptable amounts of soil loss and damages the agricultural potential and economic value of the farm. To maintain the health of the land, UDP should only support the cultivation of cassava (and other root crops) when it is to be grown in the flat, valley bottoms, or on areas where level (0-3%) terraces have already been formed by well-established cross-slope barriers.

Cassava requires heavy applications of commercial fertiliser to obtain maximum yields, because continuous cropping on the same land rapidly depletes the soil of its plant food reserves. Very low yields are obtained on impoverished soils.

Soil losses under cassava increase dramatically with small increases in slopes. For example, from 3 t/ha/yr lost on a 1% slope to 221 t/ha/yr lost on a 15% slope. Studies in Mindanao indicate that the erosion from a 44% slope is 4-6 times that from a 20% slope. In the UDP areas, cassava is commonly grown in hilly or mountainous terrain on slopes above 35%, so soil losses will be very high.

A number of cooperatives in San Isidro, Davao Oriental, have signed memoranda of agreement with San Miguel Corporation (SMC) to plant 400 hectares for the production of cassava, to be increased to 1,200 hectares in the next three years.

Cassava has been planted on slopes of 37% to an extreme of 85%. Massive soil losses of 1,300 t/ha/yr can be expected. With soil depths of only 50 cm, the economic life of the farms may only extend to a second harvest of cassava, after which the land will only support cogon grass.

A recent UDP study indicated that cultivation of corn and cassava, and other annual crops, has reduced soil depths by between 25 to 166 cm on very steep slopes in the UDP area – in one case by as much as 10 cm per year over five years.

Given the fragile, highly erodible and infertile nature of upland soils, it must be concluded that continued cultivation of cassava and corn, even on gently sloping land, is unsound land husbandry. If the uplands are to have a future for providing sustainable incomes, farmers must be persuaded to move away from growing of highly erosive annual crops (cassava and all other root crops, corn, etc).

The DENR needs to decide whether commercial cassava cultivation on sloping land is in the public interest. If the law requires the lands to be kept in a vegetative condition sufficient to prevent erosion and adverse effects on the lowlands and streams, then the necessary steps should be taken to prevent further cultivation of cassava after the current crop has been harvested.

The economic as well as ecological advantages for growing fruits should be emphasized. Bananas give 2-10 times the income than corn or cassava, make more efficient use of labour, and protect the soil.

RECOMMENDATIONS

- Cassava production, even on the gentlest of slopes, causes unacceptable amounts of soil loss and damages the agricultural potential and economic value of the farm. To maintain the health of the land, UDP should only support the cultivation of cassava (and other root crops) when it is to be grown in the flat, valley bottoms, or on areas where level (0-3%) terraces have already been formed by well-established cross-slope barriers.
- The cassava production contracts between the SMC and the Cooperatives in Davao Oriental should be cancelled. One way this could be achieved is for DENR to decide if continued cultivation of very steep slopes is in the public interest, or whether the law requires the lands to be kept in a vegetative condition sufficient to prevent erosion and adverse effects on the lowlands and streams. The DENR Secretary is empowered to take the necessary steps to expropriate, cancel effective titles, reject public land application or eject the occupants from the area.
- Involve MED in advising farmers, via UBAs and UCOs, on the profitability and marketability of various crops, citing the comparative value of crops such as bananas and pineapples compared to cassava and corn.
- Establish banks of both Vetiver grass and Napier grass on the learning sites (particularly where there are minor valleys) to meet the needs of neighbouring farms for material for cross-slope barriers. Napier grass is more effective at intercepting eroding soil than leguminous hedgerows. However, it is not as effective as Vetiver grass when planted in a single row as the gaps between stems are too wide for it to control the flow of soil and water after a heavy rainstorm.
- Protect all gentle crests, plateaux and upper slopes against erosion by planting appropriately spaced cross-slope barriers. Short- and medium-term crops should be planted on the terraces that develop. (A farmer is more willing to fell a banana tree, than a mature mango or durian tree, for example, should there be a need to return to annual crops in the future).

Problems with Cassava production in the Uplands

1. Introduction

Cassava is very demanding in its nutrient requirements. Heavy applications of commercial fertiliser (300-400 kg of complete fertiliser/ha) are required to obtain maximum yields of cassava (average 20 t/ha per crop with moderate inputs in terms of land preparation and weeding). Continuous cropping on the same land rapidly depletes the soil of its plant food reserves. Cassava can survive on impoverished soils but very low yields are obtained.

The average growth period for cassava for commercial starch production is 14 months. Some varieties mature in shorter periods of time but yields are markedly reduced. Two crops of corn a year would give a better income, with similar soil erosion losses. Bananas would give even higher income with much reduced erosion risk.

2. Past experiments in continuous cropping of cassava

Trials of cassava (Java Brown variety) interplanted with “Hawaian Giant” *ipil-ipil*, carried out on Hacienda San Jise, Makar, General Santos City, in 1976, involved a one year-old stand of “Giant” *ipil ipil* closely drilled in rows spaced one metre apart, and cut back to 10 cm stumps. Stems and leaves were laid in the space between every other row of *ipil ipil*. 25 cm long cassava stem cuttings were planted at 50 cm intervals in spaces between rows to which the green manure had *not* been added. One month after planting the cassava, the *ipil ipil* regrowth was cut back (and then every two months) and the cut material laid along both sides of the cassava rows as an organic fertiliser.

The estimated yield was 40 MT/ha of occupied area. However, since every row was not planted to cassava (as every other row was used for piling the voluminous *ipil ipil* cuttings from one year), the actual yield for the area of the farm was 20 MT/ha.

Although this trial system gave excellent results the first time, *ipil ipil* leaf production may not be adequate for successive crops of the nutrient-demanding cassava, due to severe competition for available light.

3. Soil losses under Cassava

The cultivation of cassava in hilly or mountainous terrain is particularly damaging, due to massive soil losses caused by loosening the soil when the tubers are harvested. Table 1 indicates the dramatic increase in soil losses under cassava from 1% to 15% slopes. (It took 100 years in the USA for continuous cultivation of corn on slopes of less than 3% to reduce soil depth by 37 cm).

Table 1. Soil losses under Cassava

Crop	Soil loss tons/ha/yr)	Soil loss (cm depth)
Cassava (1% slope)	3.0	0.02
Cassava (5% slope)	87.0	0.67
Cassava (15% slope)	221.0	1.70

Source: Sundquist (2003)¹

¹ Sundquist, B (2003). **The Earth's carrying capacity -- some literature reviews.** (Topsoil loss -- causes, effects, and implications: A global perspective). Edition 5, December, 2003

A UDP cooperator in Sitio Cabocanan, Mr Santos Bidiot, is growing cassava on a gently sloping crest (15-20%) between cross-slope barriers of Napier grass. He says he can see the soil moving downhill when it rains. More than two centimetres of soil were intercepted by the Napier grass hedges in one year (see difference between height of farmers' knees in Photo 1). With one centimetre of soil equating to 115-130 tons/ha/yr, the soil losses of 230-260 t/ha/yr are in the range for the 15% slope indicated in Table 1.

Photo 1. Farmer indicating depth of soil intercepted by Napier hedge in one year



Extrapolating the findings of erosion studies in Mindanao, which indicated soil losses 4-6 times greater on slopes of 44% than on 20% slopes², then soil losses of between 900-1,350 t/ha/yr can be expected from growing cassava on 45% slopes (i.e. a reduction in the depth of a clay soil of 7-11 cm per year). In Haiti, corn cultivation on 35% slopes resulted in soil losses of 402 t/ha/yr³ (a soil depth reduction of 3.7-4.4 cm).

4. Commercial production of cassava on steep slopes, San Isidro, Davao Oriental

In the UDP areas cassava is commonly grown on slopes above 35%, so soil losses will be high. In a recent development, a number of cooperatives in San Isidro, Davao Oriental, have signed memoranda of agreement with San Miguel Corporation (SMC) to "initially establish a minimum of four hundred (400) hectares for the production of cassava, which shall be increased to one thousand two hundred (1,200) hectares in the next three years for the production of corn and/or cassava".

² Midmore, D (2001). Saving soil: Integrating erosion control in upland agricultural systems (Mindanao Island, Philippines). SANREM CRSP Research Brief 2001 No. 5.

³ Sundquist, B (2003). **The Earth's carrying capacity -- some literature reviews.** (Topsoil loss -- causes, effects, and implications: A global perspective. Chapter 5). Edition 5, December, 2003

Under the contract, SMC provides technical assistance to the farmers for training, including farm visits for observational purposes. But the costs of the technicians and their farm visits have to be paid for by the cooperatives.

The TA Upland Farming Systems/Soil and Water Conservation Consultant visited some of the farms with Noa Paciencia, Project Development Officer; Felix Agut VII, Agriculturalist, and Nador Galagar, Barangay Captain on 8 September, 2004 (see site observations in Table 2).

Table 2. Site details of cassava planted under contract in Davao Oriental

PPO 2 San Isidro Sitio Cabocanan SIDOUCO	Site 1: Approx 1 ha 37% slope, Clay loam. Soil depth: 50-100cm. No hedgerows. Cassava planted in maize trash. Site 2: 2-3 ha. 85% slope, Clay loam. Soil depth: 50 cm. Young hedgerow 3 m spacing (Indiofera, Rinsones, Flemingia).. Site 3: Approx 1 ha. 45% slope, Clay loam. Mixed cropping with hedgerows 4-5 m spacing, durian, cacao, mango, lansones, banana, coconut. Fairly well shaded.
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In the extreme case of commercial production of cassava being attempted on clay soils on 85% slopes (see Photo 2), massive soil losses can be expected after the first harvest. The Consultant estimated soil losses could exceed 1,300 t/ha/year - equivalent to a potential reduction in depth of 11 cm/year. With a current soil depth of 50 cm, the economic life of that particular piece of land may only extend to a second harvest of cassava, after which the land will only support cogon grass.

The DENR should be asked to decide whether it is in the public benefit for the land to be exploited in this way, and then take action as necessary (see *Recommendations*).

Photo 2. Cassava planted for commercial production on 85% slopes



5. The future for cassava production in the uplands

A recent UDP study⁴ examined soil depths on cultivated or abandoned agricultural land and the relatively undisturbed soils with similar slopes in nearby remnant patches of secondary forest, or well-established fruit trees. The results indicated that cultivation of corn and cassava, and other annual crops, has reduced soil depths by between 25 to 166 cm on very steep slopes in the UDP area.

Given the fragile, highly erodible and infertile upland soils, it must be concluded that continued cultivation of cassava (and corn), even on gently sloping land, is unsound land husbandry. If the uplands are to have a future for supporting agriculture, farmers must be persuaded to move away from growing of highly erosive annual crops (cassava and all other root crops, corn, etc).

The economic as well as ecological advantages for growing fruits are obvious. Corn, growing on shallow soils, will fail to produce any grain if there is a dry spell of a few days. Bananas, on the other hand, give 2-10 times the income than corn or cassava (generating up to P200 compared with P15-95 per 10m² of farm), make more efficient use of labour, and protect the soil. Well-mulched pineapples, if properly spaced, can produce up to P420/10m², and are drought-resistant.

Recommendations

- Cassava production, even on the gentlest of slopes, causes unacceptable amounts of soil loss and damages the agricultural potential and economic value of the farm. To maintain the health of the land, UDP should only support the cultivation of cassava (and other root crops) when it is to grown in the flat, valley bottoms, or on areas where level (0-3%) terraces have already been formed by well-established cross-slope barriers.
- The cassava production contracts between the SMC and the Cooperatives in Davao Oriental should be cancelled. One way this could be achieved is for DENR to decide if continued cultivation of very steep slopes is in the public interest, or whether the law requires the lands to be kept in a vegetative condition sufficient to prevent erosion and adverse effects on the lowlands and streams. The DENR Secretary is empowered to take the necessary steps to expropriate, cancel effective titles, reject public land application or eject the occupants from the area.
- Involve MED in advising farmers, via UBAs and UCOs, on the profitability and marketability of various crops, citing the comparative value of crops such as bananas and pineapples compared to cassava and corn.
- Establish banks of both Vetiver grass and Napier grass on the learning sites (particularly where there are minor valleys) to meet the needs of neighbouring farms for material for cross-slope barriers. Napier grass is more effective at intercepting eroding soil than leguminous hedgerows. However, it is not as

⁴ UDP (2004). *The reduction in soil depths of upland soils in Southern Mindanao, their causes and consequences*. Report by K R S Proud, Upland Farming Systems/Soil and Water Conservation Consultant, 16 Oct 2004. Upland Development programme in Southern Mindanao.

effective as Vetiver grass when planted in a single row as the gaps between stems are too wide for it to control the flow of soil and water after a heavy rainstorm.

- Protect all gentle crests, plateaux and upper slopes against erosion by planting appropriately spaced cross-slope barriers. Short- and medium-term crops should be planted on the terraces that develop. (A farmer is more willing to fell a banana tree, than a mature mango or durian tree, for example, should there be a need to return to annual crops in the future).