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Resilience of Lowland Rice Production to ENSO (El Niño Southern Oscillation) Drougthts in Central Sulawesi (Indonesia)

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Abstract

A detailed rice farming survey was carried out at the villages of Maranatha and Rejeki (n=79 households) around Lore Lindu National Park for the growing season 2006/07 during which no water shortages occurred. Average rice yield was 4.8 t ha^{-1} $harvest^{-1}$ at two harvests per year. A Cobb-Douglas production function for paddy rice was estimated (adj. R^2: 61.9%; $p < 0.001$). Rice field size (-0.370; standardised coefficient), labour for puddling (0.109), amount of seeds (0.231), and material input costs (fertilisers, pesticides, herbicides; 0.305) were used to predict rice yield. A dummy variable testing for differences between villages was not significant. A continuous area of 476 rice plots (∼20 ha) in Rejeki mostly belonging to the surveyed farmers (91 %) was mapped, and the individual plots geo-referenced. Based on spatial design of the irrigation scheme and interview results on irrigation management, a water distribution algorithm was generated. In the 2002 ENSO drought, local water availability for paddy rice production was reduced from ∼1260 mm to ∼560 mm from July to November. Yield reactions due to water scarcity are modelled according to physiological rice demand. For the rice crop during the 2002 drought period, preliminary calculations estimate a yield reduction of 40%-49 %.

A yield reduction of 49 % in one harvest every three years instead of every four years (*i.e.*, at higher ENSO frequency) requires a productivity rise of 2.1 % to compensate yield losses. This could be achieved by a rather modest increase of material costs by 48,600 IDR (∼3–4€; +7.7 %) per hectare and harvest. To completely offset drought effects during a three-year ENSO cycle demands an increase of 8.2 % in material inputs equivalent to 207,000 IDR (∼15–17€; +35 %) per hectare and harvest. Valuated at local market prices, this represents 1 % of revenue from rice harvest per hectare. While these preliminary calculations do not make full use of the spatial and temporal resolution of the production data - and do not account for negative environmental long-term effects of intensification -, they still suggest that more intensified paddy rice production could play an important role for an increased socio-economic resilience of the local communities to ENSO droughts.

Keywords: Climate change, GIS-Model, Nopu, socio-economic adaption, STORMA, water resources

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