Recovery of agricultural livelihoods after the 2004 tsunami in the Andaman Islands, India by interventions by agricultural technologies

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Abstract

The Andaman Islands, as well as the neighboring Nicobar Islands in India were among the areas worst affected by the 2004 tsunami. Before the tsunami, the islands' hydrological schemes were suitable for agriculture because of the abundant rainfall. However, because of heavy tsunami damage to the agricultural environment, farmers have had to apply new agricultural technologies to restore their livelihoods. In natural disasters, peoples' livelihoods and the natural condition of the land need to be rapidly recovered. This paper reports how livelihoods are being recovered by intervention with agricultural technologies in the Andaman Islands, and an assessment of the recovery from tsunami damage such as the salinization of soil, and to water resources and rice fields. In the pilot study areas, the interventions have successfully recovered farmers' agriculture livelihood using newly developed technologies such as the raised crop beds with a coconut husk system or the broad bed and furrows system. Soil salinity and water resources recovered to pre-tsunami levels after two rainy seasons. A main reason for this rapid recovery was the high rainfall—more than 3,000 mm per year. However, in the case of the Andaman Islands, a successful recovery was also to the result of interventions by agricultural technologies. Farmers' livelihoods were seen to have been successfully restored through the synergy of human activities and natural hydrological schemes.

1. Introduction

In December 2004, countries bordering the Indian Ocean were hit by a tsunami that damaged ecosystems, peoples' livelihoods and hindered biodiversity. This natural disaster caused a huge loss of human and animal life, and damaged residences, fisheries and agricultural fields. The Andaman Islands, as well as the neighboring Nicobar Islands in India were among the worst-affected areas (Velmurugan et al., 2006). The islands have not experienced another such disaster in recent history. The islands lie just north of the earthquake epicenter, and the consequent tsunami was up to 15 m in the southern Nicobar Islands. The official death toll reached 1,310, and approximately 5,600 people are still missing.

Before the tsunami, the islands' hydrological scheme was suitable for agriculture because of its abundant rainfall. The main crops of the islands are rice, coconuts, spices, fruits and vegetables. After the tsunami, South Andaman Island sank slightly and North Andaman Island was lifted up several meters by the earthquake. Because of this, some paddy fields on the South Island are now below sea level and have been abandoned. On the North Island, mangrove forests dried up because of natural vegetation pattern changes due to the elevation and geomorphologic shifts. As a result of these drastic changes to the agricultural environment, farmers have had to apply new agricultural technologies to restore their livelihoods.

The tsunami devastated the livelihoods of the residents of the island with losses of natural resources, disjuncture of communities and the disturbance of industrial activities. The income of those affected is still partly dependent on tsunami relief funds from the government. In disaster situations, peoples' livelihoods and the natural condition of the land need to be rapidly recovered. This paper reports how livelihoods are being recovered by interventions of agricultural technologies in Andaman Islands.

2. Study area

The Andaman Islands (Fig.1) are located in Indian Ocean, and lie between latitude 11 and 14° North and between longitude 92° and 94° East. There are 572 islands in the territory, of which only approximately 38 are permanently inhabited. Most of the islands (about 550) are in the Andaman group, 26 of which are inhabited. The highest point is located in North Andaman Island (Saddle Peak at 732 meters). The total area of the Andaman Islands is approximately 408 km^2. Average annual rainfall of Port Blair is 3180 mm, and there were 149 days of rain at Port Blair were in 2003. Mean minimum temperature was 23.9° C and mean maximum temperature was 30.2° C. The total population of the islands is approximately 356 thousand.

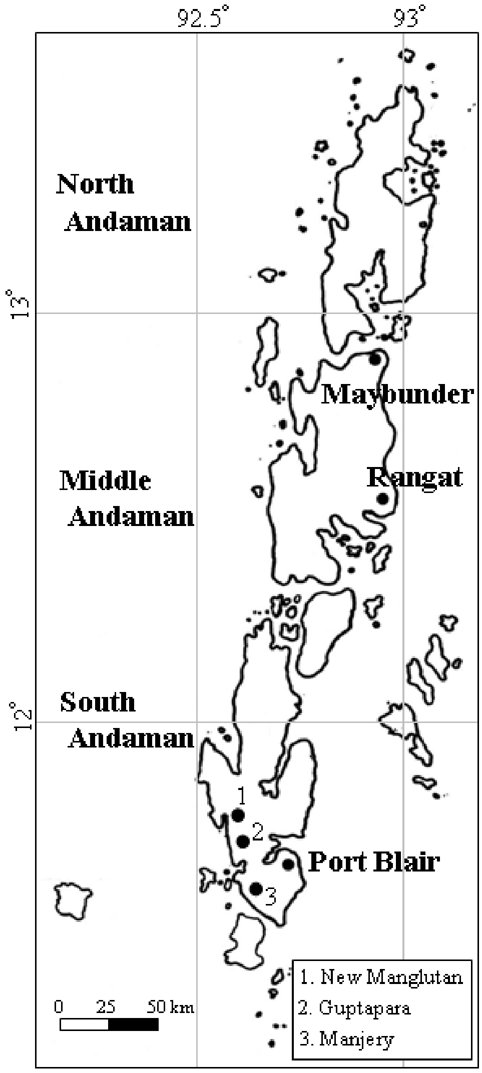

Fig.1 Study sites on the Andaman Islands.

The total agricultural area in the Andaman and Nicobar Island groups is 48,675 ha. In the Andaman Islands, the main crop is rice, whereas coconut and areca nut are the biggest cash crops on the Nicobar Islands. Pulses, oilseeds and vegetables are also grown, with by rice grown during the Rabi season. Many kind of fruit such as mango, sapota, orange, banana, papaya, pineapple and root crops are grown in hilly regions. Spices such as pepper, clove, nutmeg, and cinnamon are grown in a multitier cropping system. Rubber, red oil, palm and cashew are also grown on a limited scale on these islands.

3. Interventions of agricultural technologies and impact assessment of the tsunami on the ecosystem

Four villages (Fig.1)—New Manglutan, Guptapara, Manjery and Indiranagar (not shown in Fig.1)—in South Andaman were selected for the pilot study. Agricultural intervention

Table 1. Technological interventions made in various situations

No.	Situation	Technological interventions
1	Low-lying coastal areas where there is permanent groundwater infiltration by sea water and the depth of sea water increases with high tide	· Family poultry production for immediate livelihood and nutritional stability · Goat farming · Detection of reproductive disorders and the implementation of therapeutic measures in cattle · Use of azolla as a feed supplement for backyard poultry
2	Low-lying coastal areas into which sea water advances with high tide and recedes with low tide	· Assessment of spatial and temporal variability in soil · Technological interventions for managing degraded natural resources · Raising crop beds with coconut husk applied for salinity management · Broad bed and furrow system for soil and water management · Brackish water-based Integrated Farming System (IFS)
3	Low lying coastal areas where sea water has intruded, only during the Tsunami—receding permanently afterwards	· Assessment of temporal and spatial status of soil and water · Mat nursery and system of rice intensification method of paddy cultivation · Crop diversification through the introduction of vegetables · Freshwater pond based IFS · Participatory water resource development and management through Water User Association

technologies were applied to different areas dependent on the level of tsunami damage and the site location. In addition, impact assessment was conducted on the soil, water, and crop yield. Table 1 summarized the details of interventions made in each situation (Srivastava et al., 2009a, 2009b).

Interventions such as the application of raised crop beds with coconut husks (RCBCH) for salinity management, and broad bed and furrow (BBF) system for soil and water management, which were applied in low lying coastal areas where sea water advances with high tide and recedes with low tide, are shown in this paper. The results of impact assessment are also reported.

4. Recovery of livelihood after the interventions

4.1 RCBCH application for salinity management

A mound sized 1 m wide and 0.3 m high is prepared, and compost is mixed with soil for fertilization. Coconut husks cover the ridge to guard vegetables against continuous and heavy rains (Fig.2). The advantages of the RCBCH method are increasing microbial content in the soil and the improvement of acidic soil by increasing soil pH. The coconut husks also serve as a rich source of potash. Of seven pilot fields were selected, and the net profit from the fields was from 50,000 to 75,000 Rs. per ha.

Fig.2 Raised beds with coconut husk application (photo from Srivastava, 2009)

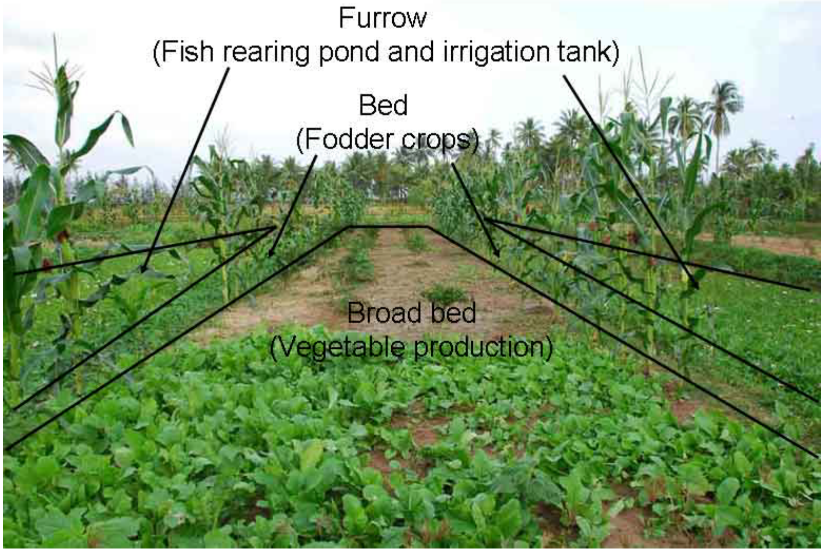

Fig.3 Broad Bed and Furrow (BBF) system in the pilot study area

4.2 BBF system for soil and water management

The Inhibited growth of vegetables and the dilution of fodder is caused by excess rainfall during the rainy season (June–December). In contrast, during the dry season vegetable production is significantly damaged by snails, bacterial wilt and a shortage of water. The BBF system for soil and water management is a kind of integrated farming system to grow vegetables, enhance fodder and to rear fish (glass carp) in rice fields using water harvested in furrows throughout the dry season.

As shown in Fig.3, the BBF system has a central broad bed (4 m wide and 1 m in height) and narrow beds and furrows (6 m wide and 1 m deep). Vegetables and fodder crops are planted in the broad bed and narrow beds, respectively. Glass carps are rearing in the furrows and harvested water are used for irrigation. The resulting net returns for the first year were 62,000 Rs. per ha, from the combined sales of the vegetables, rice and fish. In the second year, income nearly doubled (117,000 Rs. per ha). The small return in the first year was due to the construct costs associated with the BBF system.

5. Results of impact assessment on soil, water, and vegetation

Changes in salinity status of soil and water have already been reported (Nayak et al., 2009, Raja et al., 2009). Low-lying coastal areas were affected by the tsunami and some areas remain salinized because of drainage problems. Therefore, ponds and dug wells in some areas are still affected by salinization.

Before the tsunami, electrical conductivity (EC) of soil saturated paste was found to be 0.32 dS/m and 0.04 dS/m at 0–0.15 m and 0.15–0.3 m soil depth, respectively. Immediately after the tsunami, it increased sharply and ranged from 7.6 to 34.4 dS/m at 0–0.15m soil depth. However, after one rainy season, the levels decreased to 6.8 to 11.2 dS/m. After the second rainy season, significant decreases in ECe were found that ranged from 3.7 to 7.6 dS/m. In addition, soil pH was also close to pre-tsunami levels in most cases after both rainy seasons.

EC of wells and pond water ranged from 2.3 to 11.8 dS/m after the tsunami, and decreased to below 2.0 dS/m in most areas after two rainy seasons. In the case of the islands, gypsum application was not needed for the rehabilitation of salinized soil because rainfall had leached enough salt from the soil and drained salt from aquifers.

Impact assessment of the effects of the tsunami on vegetation was reported by Venkatesh et al. (2006). After one rainy season, rice yield in areas where the tsunami damage was estimated to be severe was reduced by 59% of that in non-affected areas, and to 37% of pre-tsunami yields in moderately affected areas.

6. Summary

Interventions successfully recovered farmers' agriculture livelihood through the application of newly developed technologies such as the RCBCH and BBF systems in the pilot study areas. The tsunami-affected saline soils were recovered to pre-tsunami levels after two rainy seasons. The ECs of pond water and dug well water were low enough (less than 4 dS/m) for agricultural production. There are no data about rice yields after recovery. However, rice yields may have fully recovered after two rainy seasons, considering the decrease in soil, pond, and dug well water ECs. The main reason for the rapid recovery in the affected areas was heavy rainfall. In the case of the Andaman Islands, the success in recovery of livelihoods was also due to agricultural interventions. The successful recovery of livelihoods in the Andaman Islands shows the effectiveness of the synergy of human activities and natural hydrological schemes.

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