

Master thesis  
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# Water regime in paddy rice systems in Northern Vietnam



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The objectives of the present study were (i) to quantify the vertical infiltration of paddy fields and adjacent bunds, (ii) to assess the lateral flow through bunds to fish ponds, (iii) to identify the processes responsible for water losses through bunds and (iv) to compare different bunds and fields in terms of water losses. Moreover, (v) frame infiltrometry with chloride as tracer was tested concerning measurability of the breakthrough time and recovery rate of water from the paddy field to the pond through the bund.

In Yên Châu, Northern Vietnam, four paddy fields and their adjacent bunds bordering to fish ponds were studied concerning water losses. Double ring infiltrometers were used to measure vertical infiltration in the fields as well as in the bunds. Infiltration was measured in field surface depth and in plough pan depth to investigate infiltration behaviour of both layers. Ponding water depths of 3 cm and 5 cm in the infiltrometers were chosen to represent the common ponding water depths in the fields. Frame infiltrometry was accomplished to measure infiltration rates into the bund as well as through flow of water. For this purpose a metal frame was installed in the plough pan of paddy field, reaching into the bund. A collecting pan in the same section of the bund was inserted on the pond side in water level height. Chloride was used as tracer to detect water flow velocity and recovery rate. Brilliant Blue was further applied to visualize pathways of flowing water through the bunds.

According to objective (i), double ring infiltrometry showed low and no infiltration of water in the fields. In the bunds mean vertical infiltration ranged between 0 and 154.0 mm d<sup>-1</sup>. A remarkable heterogeneity of infiltration rates within and between the bunds was observed. Concluding, vertical water losses did not occur within the fields but in the bunds. Owing to objectives (ii) and (iii), infiltration from the frame into the pond was more homogeneous. However, chloride tests resulted also in variable findings in terms of breakthrough time and recovery rate of chloride. The fact that most of the matrix was not coloured by the Brilliant Blue dye and breakthrough times were short led to the statement that the main part of bund flow happened via preferential flow. Preferential flow pathways were identified as macropores due to roots and edaphic fauna. Desiccation cracks may have formed within the bunds due to clayey soil texture. Dye experiments displayed preferential pathways from the paddy to the pond in all studied bunds. Much of the infiltrated water was lost through vertical percolation within the bund and caused low recovery rates. Furthermore, unstained water flows were recognized within the bund in the framed area. Thus,

preferential pathways criss-cross the bund. With regard to objective (iv), vegetation cover in terms of rooting depth, use of the bund as pathway in terms of compaction, height gradient between paddy and pond, ground water table and edaphic fauna were the main factors influencing bund water flow. Bunds 1 and 3 as well as bunds 2 and 4 were found to be similar in attributes like vegetation cover, compaction, ground water table and elevation gradient. Bund 1 and 3 showed highest recovery rates and highest infiltration results from double ring infiltrometry. This happened due to deep rooting vegetation cover, low compaction, little height distance between field and pond, high groundwater table and high abundance of edaphic fauna. Bund 2 and 4 showed opposite attributes resulting in low recovery rates and infiltration via double ring infiltrometry. With respect to object (v) the method was proven to work out well in field studies.

Concluding, paddy bunds were vulnerable to high water losses as already described in former studies. Within the field, water losses were negligible. The responsible process for bund flow was preferential flow. Water was deep percolating in direction to the ground water. Furthermore, it was flowing horizontally to adjacent fish ponds despite the absence of a hard pan. It was transported there via preferential pathways.