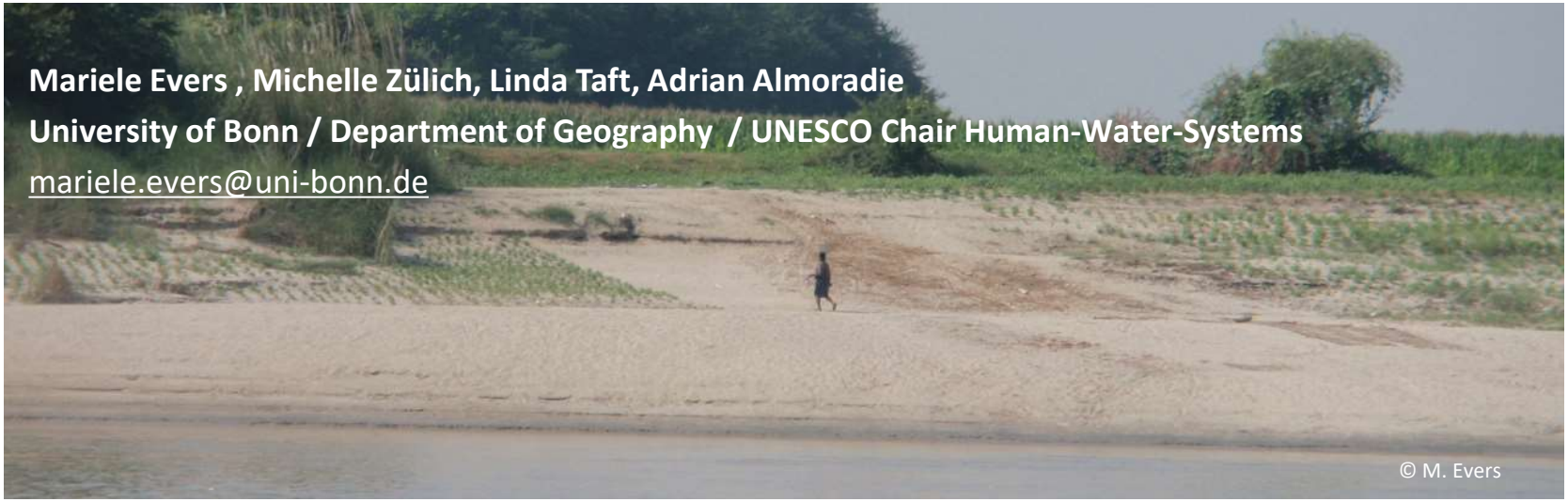
Alluvial farming in Ayeyarwady floodplains - spatio-temporal dynamics of a complex human-water system



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Outline

- Introduction
- Research objectives and methodology
- Findings (selected)
- Conclusion and further research

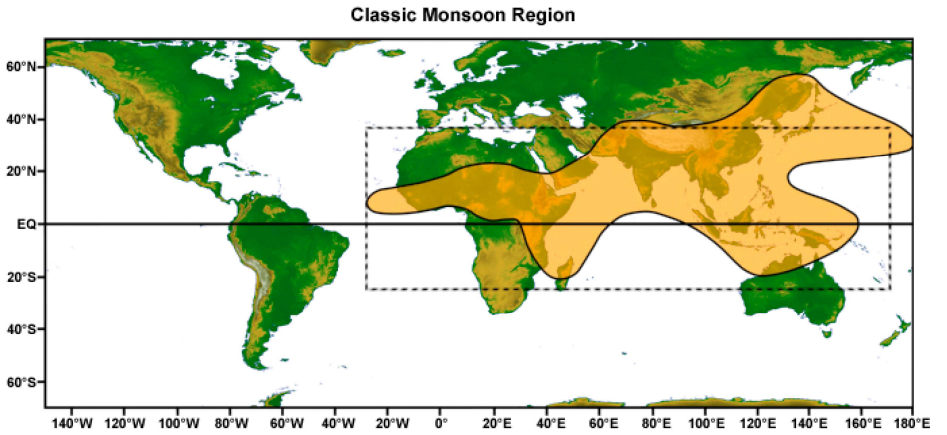
Examples of alluvial farming in Ayeyarwady Floodplain

Outline

Introduction	What is alluvial farming and why is it relevant? The case study: floodplains along Ayeyarwady river in Myanmar
Research objectives and methodology	Examination of spatio-temporal dynamics and interactions, hydrological variabilities/extremes and adaptation strategies with a pluralistic and mixed method approach
Findings (selected)	Specialised spatio-temporal system, increase of alluvial farming ratio, push and pull factors identified
Conclusion and further research	Relevance of alluvial farming as a source of income and adaptation strategy to drought is increasing, inherent coupling effects, role of floods?

Introduction – alluvial farming

- Floodplains are important locations for agricultural production in many regions of the world
- In monsoon-dominated regions with a pronounced rainy season floodplains are often used seasonally → can improve food security and income of poor households.
- Alluvial farming benefits from fertile sediment deposits, residual moisture in the soil and good access to water from the river or groundwater.
- At the same time, farmers have to deal with flood risks and highly dynamic hydromorphological and hydrological conditions.



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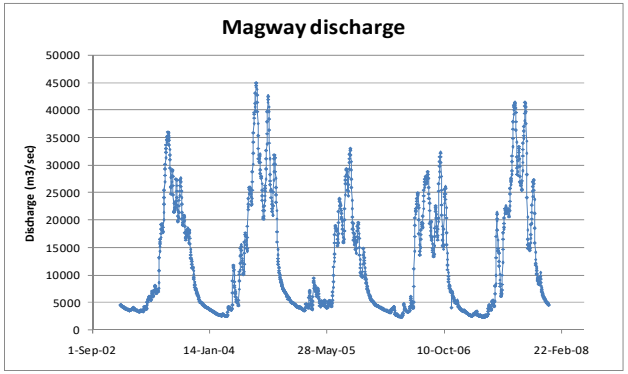

Annual discharge at Magway gauging station (2002 – 2008)
Own calculation

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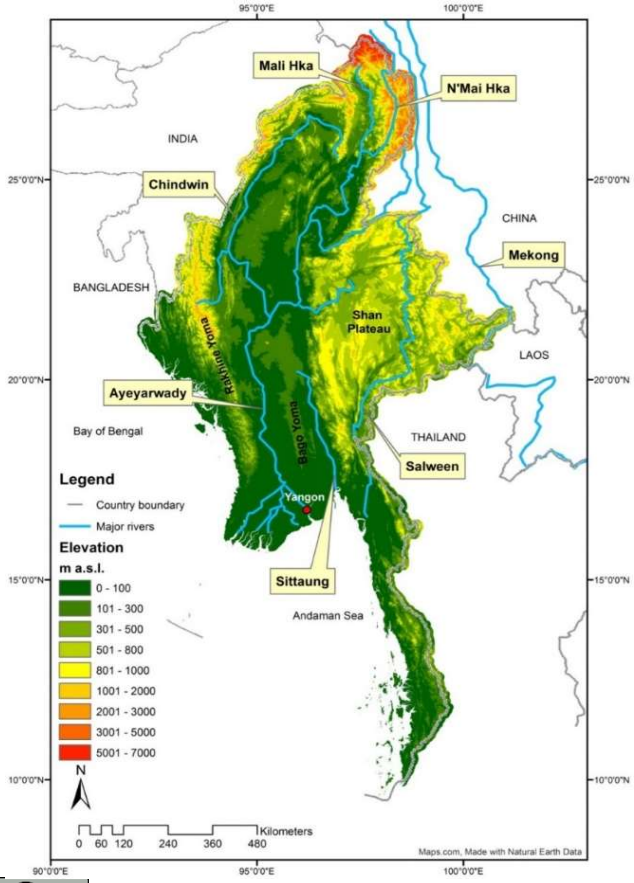
Introduction - Myanmar



Ayeyarwady/ Irrawaddy:

→Lifeline & Waterway

- Length: 2.170 km
- Catchment area: 413.700 km²
- 75% of country area
- Mouth of the Ayeyarwady Delta in Andaman Sea
- Most important lifeline & major waterway (1,500km navigable)
- no dams influencing the flow until now
- Very high sediment loads (265 - 340 Mio. t/a)

Hydrographie Myanmar (Taft & Evers 2016)

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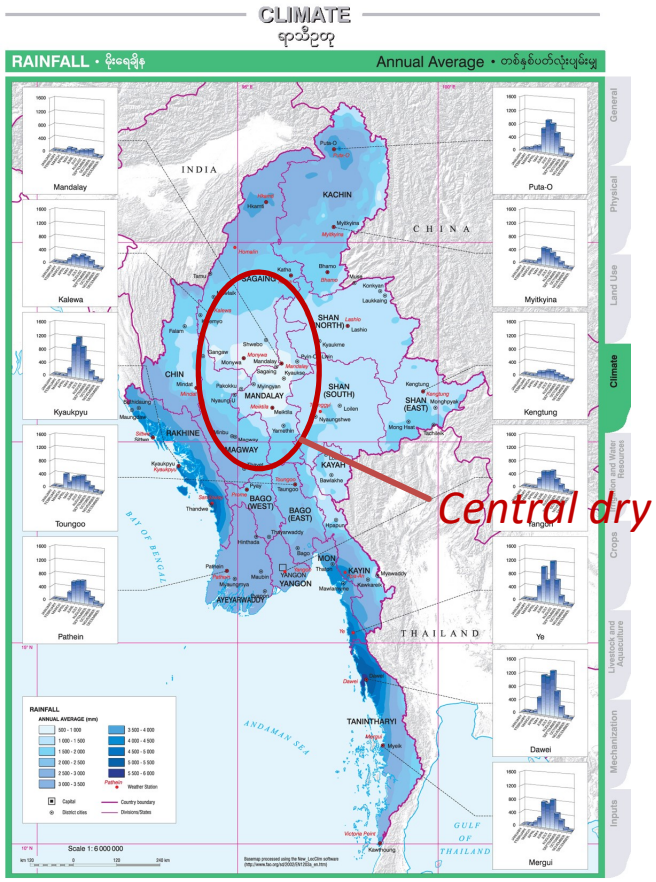
Introduction – central dry zone



- Central dry zone is particularly vulnerable
- High spatial and temporal precipitation heterogeneity
  - High population density
  - Agriculture as important factor for > 14 Mio. people
    →Challenge: water shortage, crop failure
  - 58% of the population in agricultural sector
  - Low share of agricultural irrigation (12% of cultivated areas)
- Drought in spring 2016 (1997/98, 2010, 2014) and floods in July/August 2016
  - Risks: Drinking water supply, risk of diseases, food insecurity, fire hazards

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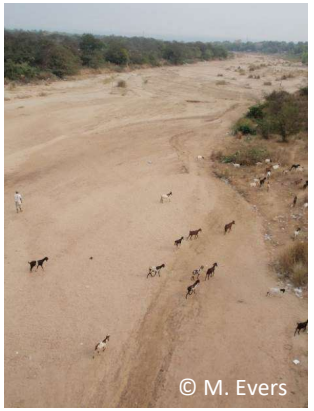
Introduction – central dry zone

- Agriculture is the main economic activity in Myanmar and accounts for 38% of the Gross domestic product.
- Challenges: increasing water demand, precipitation variability
- The most important production areas are the central drying zone (CDZ) and the Ayeyarwady Delta.
- The CDZ is particularly characterized by irregular rainfall, significantly rising temperatures, droughts, a shift in the onset of the rainy season and extreme flood events, which makes agricultural production very challenging and difficult.



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Research objectives and methodology

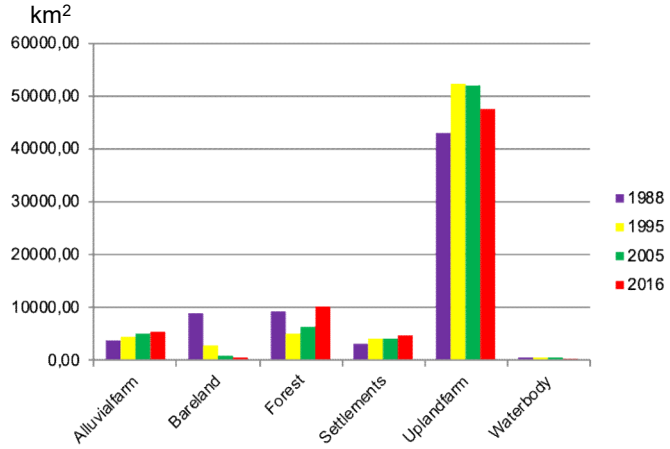
Research objectives

- Identification of relevant components shaping the complex human-water system of alluvial farming in the Ayeyarwady floodplain
- Examination of spatio-temporal dynamics of the alluvial farming system and the interactions between hydrological variabilities and extremes and the handling of farmers
- What adaptation strategies are applied by the farmers to this dynamic system and coping with hydrological risks

Methodology

- Pluralistic water research (PWR) framework as concept for the study (Evers et al. 2017)
- Change detection based on satellite images to identify changes in land use and alluvial farming areas
- hydrological data analysis to identify the dynamics of the seasonality of precipitation and discharge
- on-site mapping to identify spatio-temporal dynamics of the alluvial farming system
- surveying farmers to identify adaptation strategies

Findings (selected)



Land use change in central dry zone. Own analysis

Kaing at Magway District (Chauk)

Kyun at Pakkoku Township

- Landuse change in the central dry zone : Alluvial farming increased from 1988 (5,1 %) to 8,2 % in 2016
- A special terminology is established for alluvial farming: *Kyun* (farmland on the sandbars) and *Kaing* (farmland on the terraces)

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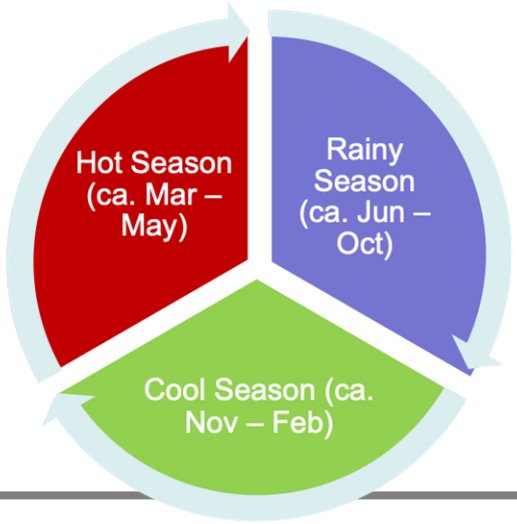
Findings (selected)

Spatio-temporal dynamics of alluvial farming (case of Pakkoku)

Late harvest and sale of the cash crops on the market. Job search for the months until the next season



Due to flooding, no use of alluvial land possible → Part-time employment in other areas (cooperation on the market, craft activities etc.) necessary to generate income

Alluvial Farming on Khaing and Kjung depending on flood and hydromorphodynamics (water level, drying out of land, location of land)

- **Sep/Nov to mid/end Dec.**: Gradual cultivation of agricultural land
- bush removal by (motorised) scythe and burning of organic material
- Removal of waste and flotsam
- Levelling of the land/ preparation of the fields (with ox carts and/or agricultural machinery → direct sowing of the seeds as soon as the land is ready for agriculture (no fixed period, no cultivation calender available
- **Feb**: Start of harvest

Findings (selected)

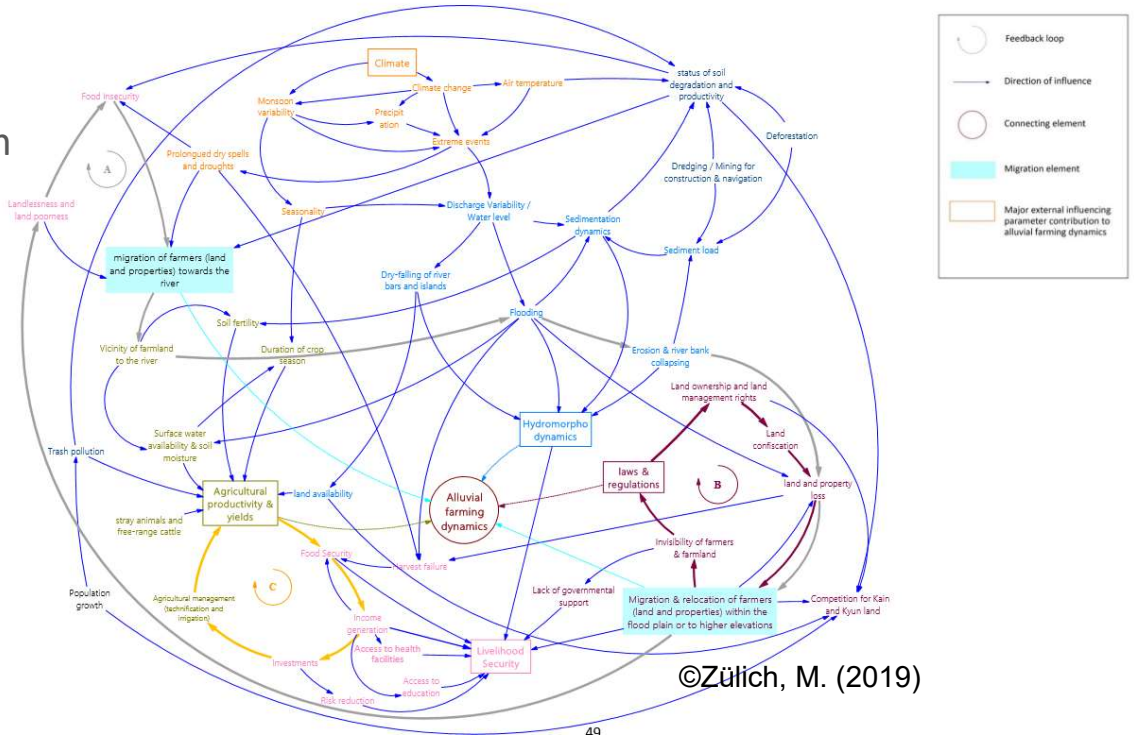
Push and pull factors for alluvial farming

Push factors	Pull factors
Reoccurring prolonged dry spells and droughts	Increased soil fertility
Widespread soil degradation and low soil productivity	Surface water availability & higher and longer residual soil moisture
Land poorness and landlessness	Availability of accessible land resources
Food insecurity	

Findings (selected)

The spatio-temporal system is more complex. Identification of push and pull factors only do not allow understanding the system. System dynamic analysis identifies interconnected factors and feedback loops.

Influence diagram



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Conclusion and further research

Selected results

- Strong spatial-temporal hydrological seasonality and variability of the Ayeyarwady river bank systems
- Relevance of alluvial farming as a source of income and adaptation strategy to drought is increasing
- Adaption system established to cope with spatial-temporal seasonality and variability
- Clear pull and push factors can be defined BUT the system is much more complex
- System dynamic analysis identifies interconnections and feedback loops

Further research questions

- How could hydro-meteorological changes (temperature rises, precipitation patterns) influence cultivation conditions?
- Are changing flood patterns increasing the risks or how resilient is the established system?
- How will the socio-economic (e.g. population, economy, migration) factors influence alluvial farming?
- What are the differences and similarities regarding alluvial farming practices compared to other regions / countries?

Abstract

Mariele Evers, Linda Taft, Michelle Zülich, and Adrian Almoradie (2020) Alluvial farming in Ayeyarwady floodplains. Spatio-temporal dynamics of a complex human-water system

Floodplains are important locations for **agricultural production** in many regions of the world. In **monsoon-dominated** regions with a pronounced rainy season, the **floodplains are often used seasonally**, which can improve **food security** and the income of poor households in particular. **Alluvial farming** benefits from **fertile sediment deposits, residual moisture in the soil and good access to water from the river or groundwater**. At the same time, farmers have to deal with **flood risks** and **highly dynamic** hydromorphological and hydrological conditions.

Agriculture is the main economic activity in **Myanmar** and accounts for 38% of the Gross domestic product. The most important production areas are the **central drying zone (CDZ)** and the Ayeyarwady Delta. The CDZ, however, is particularly characterized by **irregular rainfall, significantly rising temperatures, droughts**, a shift in the onset of the rainy season and **extreme flood events**, which makes agricultural production very challenging and difficult.

By using the **Plural Water Research framework** the physical and human boundary conditions of a research area in a floodplain in the CDZ were studied in order to identify relevant components which are shaping this **complex human-water system**. With the help of satellite images, hydrological data, on-site mapping and surveying farmers, the **spatio-temporal dynamics of the alluvial farming system** was examined and the **interactions between hydrological variabilities and extremes** and the **handling of farmers** within this complex system were examined and **adaptation strategies** were identified.

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