



# Protecting water quality and living organisms in streams

Stream water is an essential resource for many people living in the country side providing water for drinking, washing, farming and cattle. Streams are also the living place for many organisms including fish and insects spending part of their life cycle in the water. However, agriculture and other human activities might pollute the water and thus harm the resource for people as well as the living organisms in the streams. Understanding how different land uses affect water quality and living organisms in streams is thus important. Our study in Jimma Zone, Oromia regional state, southwestern Ethiopia shows that forests and wetlands help to keep stream water clean and cold. In contrast, streams flowing through areas dominated by agriculture, coffee agroforestry or settlements have poor quality and lower numbers of sensitive organisms to pollution. Urgent management actions are needed to protect stream water quality both for living organisms and because these streams are widely used by the rural community for daily activities.

## Importance of water and land use

Natural resources around the world are under increasing pressure as the population grows and people use land more intensively, even in remote areas. This heavy use affects nature, biodiversity and the resources that communities depend on. In response, the United Nations (UN) established 17 goals for sustainability to find ways for us to both 'eat the cake and save the cake' (i.e. improve people's lives while protecting the environment). In particular, the UN's water goal (sustainable development goal 6) aims to ensure access to safe and clean water for all while protecting water-related ecosystems. In tropical rural areas, communities practice mixed farming and depend heavily on stream water.

However, we still know little about how land use and other human activities affect water quality and living organisms in streams even though this is critical for clean water and protection of nature.

## What we did

We studied 46 streams in Jimma Zone of Oromia regional state, southwestern Ethiopia. We tested water quality (chemical properties and harmful bacteria) and counted small living organisms (mainly aquatic insects) in streams (Figure 1). Some of these insects are good indicators of water quality and their abundances helped us understand if a stream is clean or polluted. For each watershed (area draining to the stream), we estimated the proportions of land use types such as forest, agriculture, agroforestry and wetland. We also estimated the number of households (settlement density) and recorded the presence of coffee washing stations.

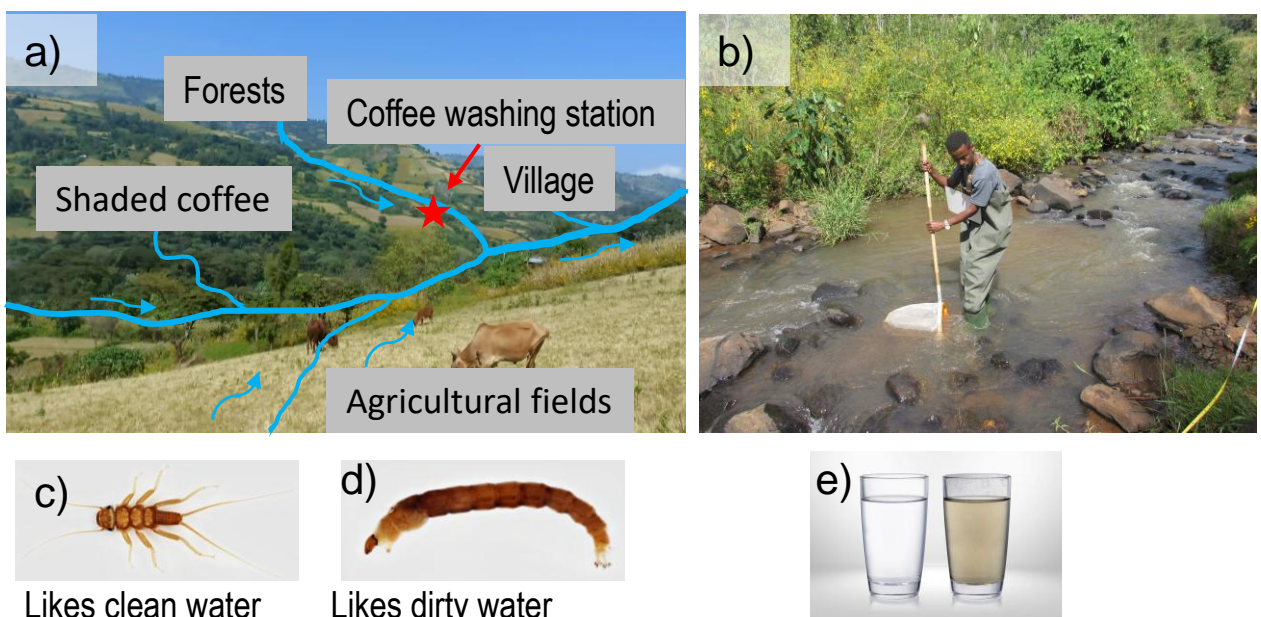


Figure 1. Overview of the study system. a) Watershed with different land uses such as forests, agriculture, patches of shaded coffee agroforestry and settlement areas b) collecting small organisms from a stream using a net c) small organisms collected from streams as indicators of clean and dirty water e) clean and dirty water.

## What did we find?

We found that streams flowing through forest and wetland areas had cleaner water. In contrast, streams draining areas dominated by agriculture, coffee agroforestry and villages had more pollution such as particles and nutrients, and harmful bacteria (Fig 2a-c). The effect of coffee agroforestry (areas with coffee grown under trees) was more similar to agriculture than to forests. This surprised us since agroforestry is regarded as a relatively low-impact agricultural method. Waste from settlements and coffee washing stations was a major source of pollution. Clean streams had more sensitive living organisms (insects) (Fig 2d). The sensitive insects prefer clean and cold water for their habitat. Most streams had harmful bacteria far above World Health Organization (WHO) safety limits.

## Conclusion

Streams draining forest areas had better water quality and different freshwater organisms compared to streams draining agriculture or coffee growing areas. Even small areas of wetlands, helped to improve water quality by reducing nutrients, cloudy water (turbidity) and harmful bacteria.

Downstream of coffee washing stations and settlements the water quality was poor (i.e. in terms of turbidity and nutrient pollution) and there were fewer sensitive living organisms.

## Recommendations

We suggest that priority is given to the following actions to reduce risks to human health and living organisms in streams:

- Proper treatment and control of waste from households and wet coffee washing stations.
- Raising public awareness about stream water pollution, especially bacterial contamination, given the widespread reliance on stream water in rural areas.
- Protecting and restoring vegetation along stream banks to reduce surface runoff.
- Protect and restore wetlands.
- We also need more studies on how to manage coffee production to reduce negative effects of this land use and utilize the positive effects that the shade trees can provide.

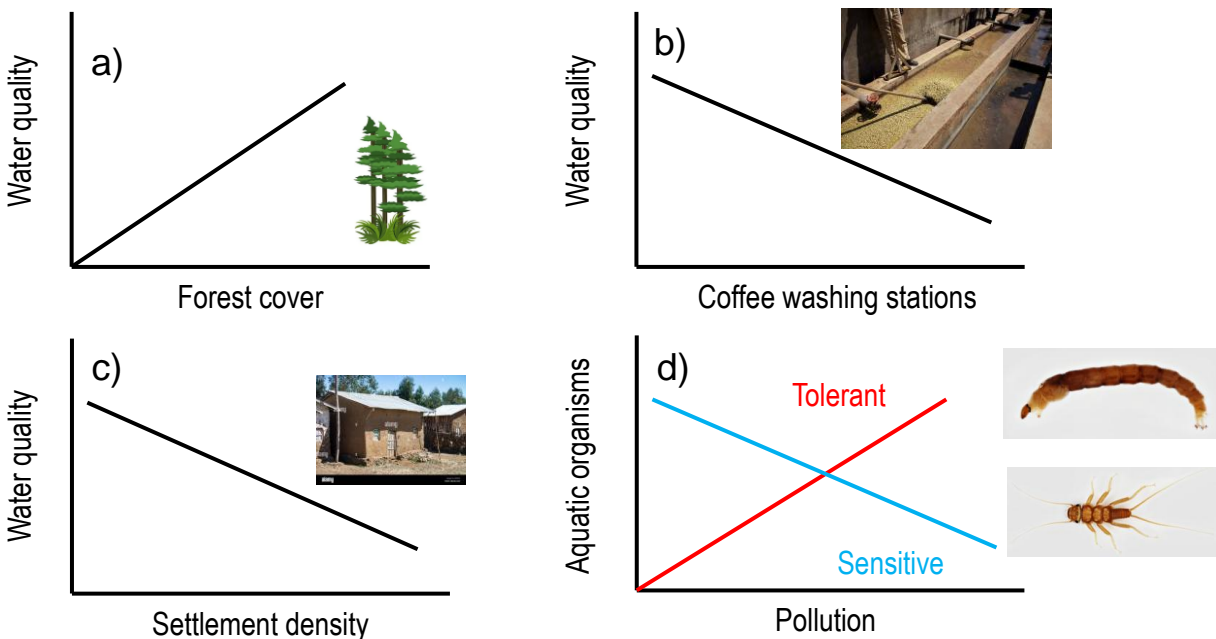


Figure 2 Effects of land use and human activities on water quality and freshwater organisms. a) better water quality in catchments with high forest cover b-c) poorer water quality in streams with more coffee washing stations and high settlement density d) pollution from settlement areas and coffee washing stations negatively affected sensitive organism (insect) and favoured tolerant organism (insect).

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