Implementing Community-based Agrivoltaic Systems in SSA: Challenges and Mitigation Strategies

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Background

Rural communities and smallholder farmers face many challenges in West Africa

- Rainfed agricultural activities and pastoralism represent the major activity for most countries in West Africa *(ILO, 2020)*
- Smallholder farmers face severe challenges as rainfall patterns remain unreliable, erratic and in most cases insufficient
  → low productivity and food insecurity *(Moyo et al., 2015)*
- Further exacerbation by climate change impacts (higher temperatures and abnormal rainfall)

➢ Decreased crop growth and shorter crop cycles

➢ The presence of droughts and soil degradation *(Lal, 2009)*


Photo: Fraunhofer ISE

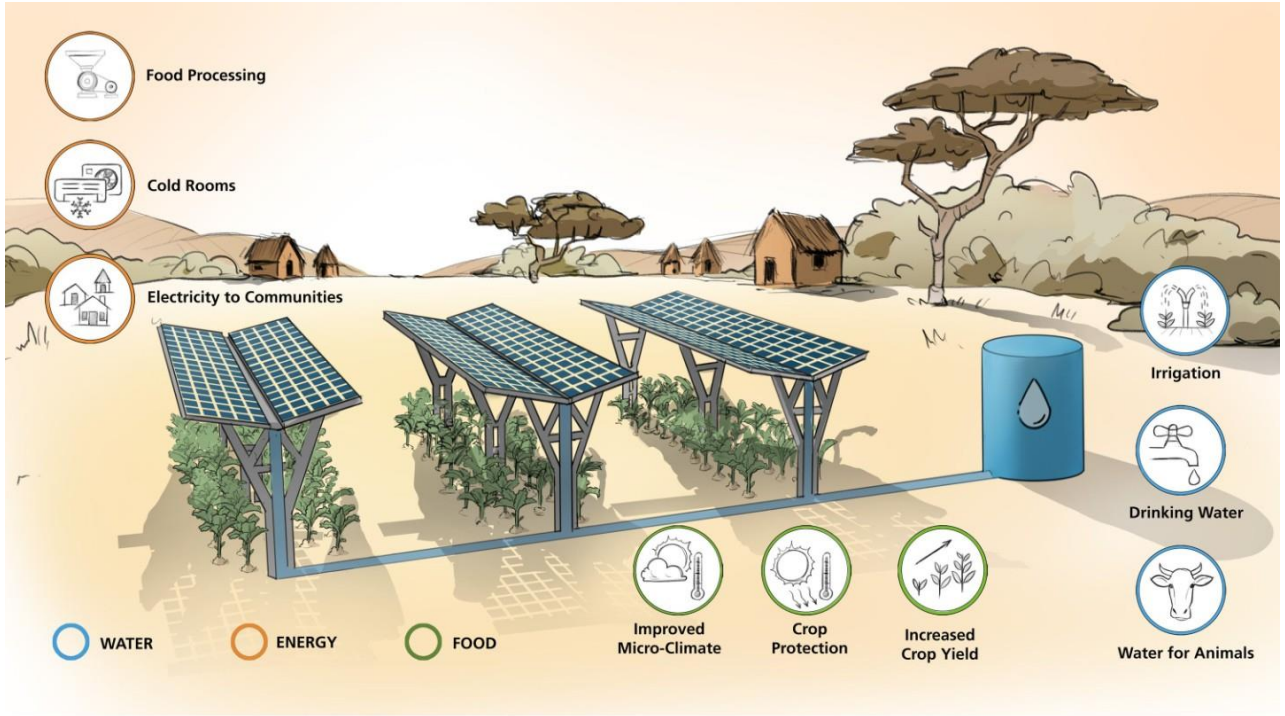

Photo: deea solutions GmbH

Agrivoltaics and the WEF-Nexus

Concept

Potential advantage over conventional PV applications due to dual-land use

- Agricultural activities and solar energy generation on one piece of land
- Protection of crops from direct sunlight and heavy rain / hail
- Integration of water management systems possible; reduced evaporation



Source: Fraunhofer ISE

Agrivoltaics holds the potential to mitigate increasing desertification, improve drinking water supplies, help secure local food supplies, and drive socio-economic development

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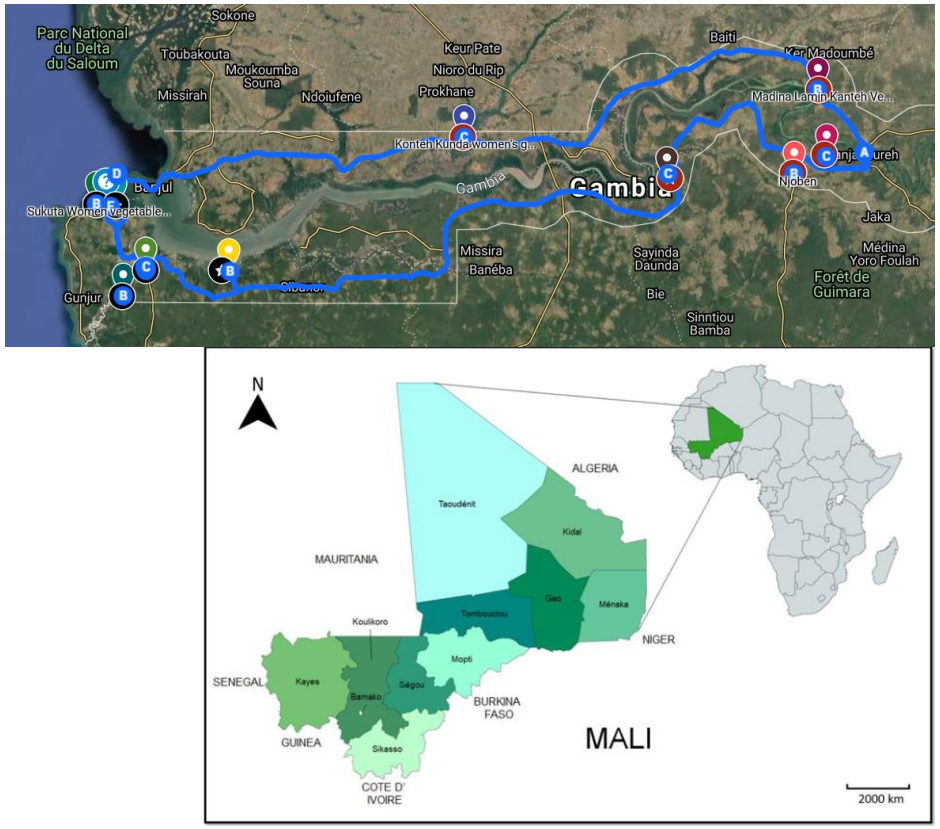
APV-MaGa – Agrivoltaics for Mali and The Gambia

Sustainable Electricity Production by Integrated Food, Energy and Water Systems

Project aims:

- Testing the technical and economic viability of an integrated triple land-use system (Agriculture, Solar generation, Water management)
- Contribute to a more ecological and socio-economic sustainable development of the partner countries and in general, the West African economy.
- Revealing challenges and opportunities of APV systems and
- Gaining a deeper understanding of synergies and interactions between the Food-Water-Energy-Nexus.



Cheo et al. 2022

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What are the challenges of implementing community-based agrivoltaics in SSA?

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Renewable energy projects face challenges in SSA

Political, social, and organizational aspects play a key role

Ikejemba and colleagues (2016) found reasons for failure of RE projects in Sub-Saharan African countries to be similar:

- Political agenda
- Process of awarding projects
- Stakeholder co-operation
- Planning & implementation
- Maintenance
- Public acceptance & inclusion

Success of projects is inextricably linked to human behavior

(Ikejemba et al., 2016; Burke et al. 2001)

Study on risks of implementing AV in rural communities in SSA

Adelhardt & Berneiser (2024)

Aim

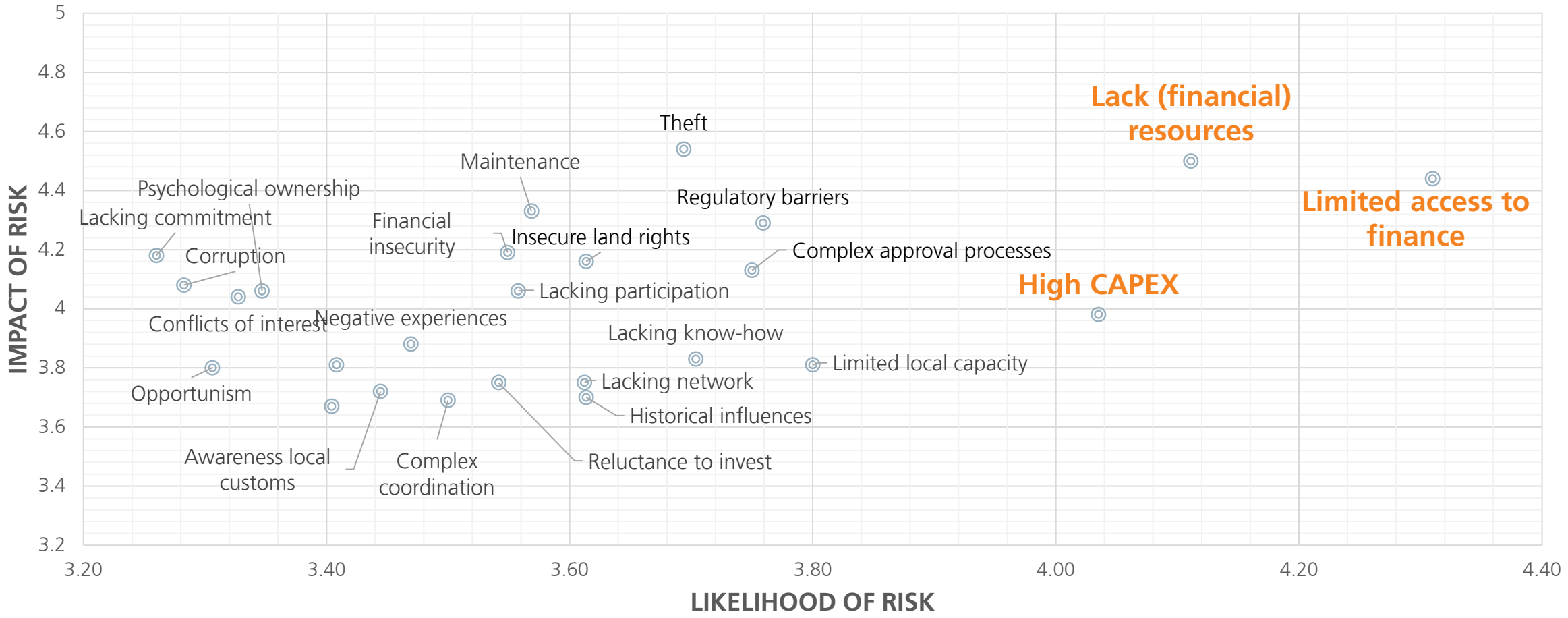
- Identification of risk factors when implementing agrivoltaics at a community level in SSA
- Examine the perceived probability and the anticipated severity of these risks
- Identification of potential mitigation strategies to diminish the risks

How

- Mixed-methods study (qualitative interviews and survey)
- Qualitative interviews: 12 semi-structured expert interviews between July 2021- July 2022
- Survey: Professionals working in rural electrification; $N = 58$; diverse backgrounds

Likelihood and impact of risks

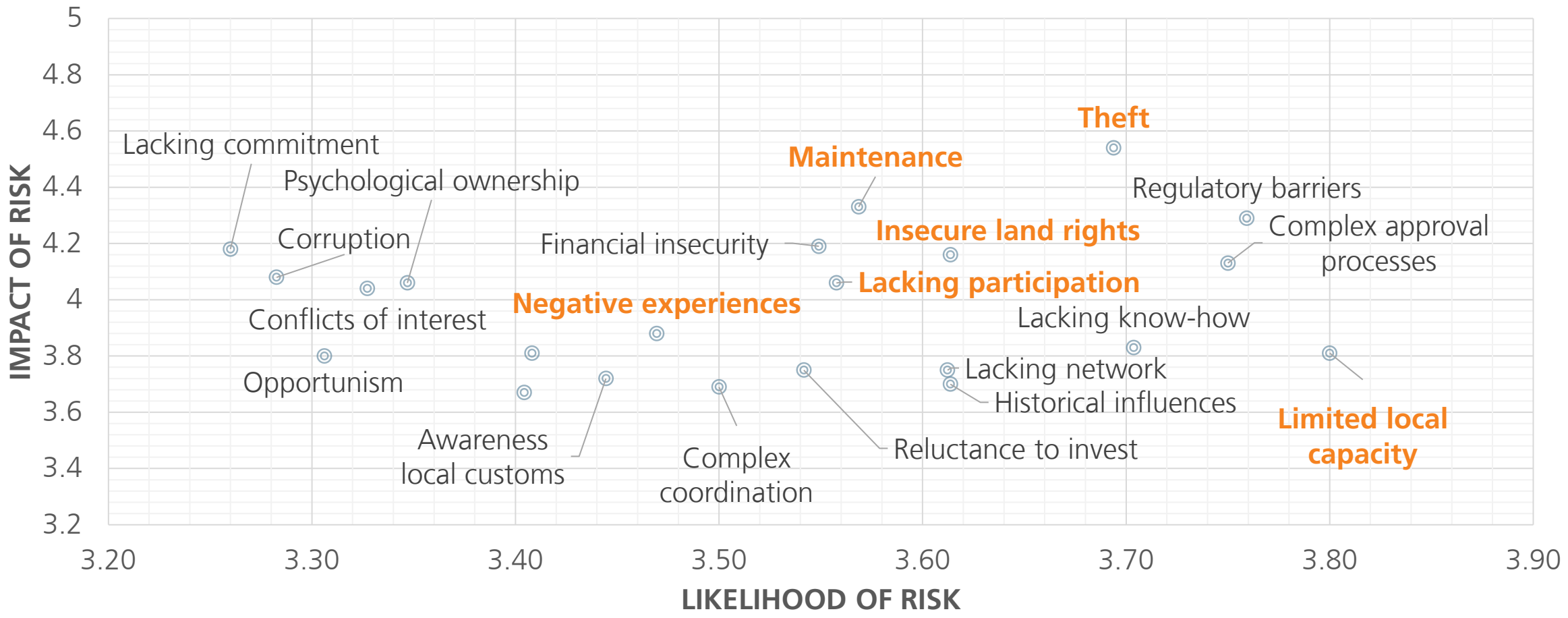
Financial aspects were considered as risks very likely to occur during project realization



Adelhardt & Berneiser (2024)

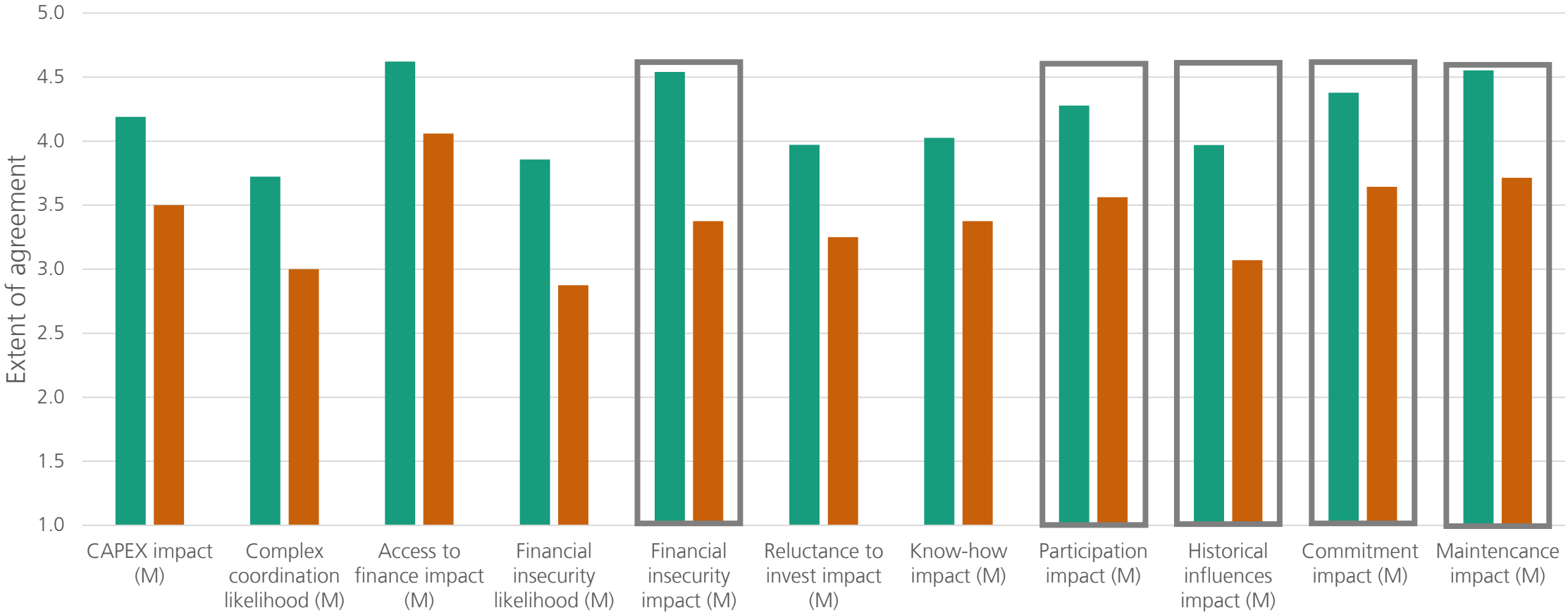
Likelihood and impact of risks

However, also political, social, and legal aspects were considered as likely and impactful risks



Adelhardt & Berneiser (2024)

Higher risk perception among professionals with work experience in Africa



Adelhardt & Berneiser (2024)

$p < .05$

What are potential mitigation strategies for implementing community-based agrivoltaics in SSA?

Mitigation strategies

Participation, stakeholder engagement and regulatory, financial support mechanisms considered essential

1. **Participation and education**
   Inclusive planning; 3 Cs throughout the project; bottom-up approaches, acknowledging local cultural contexts; sensitization and training
2. **Financing mechanisms**
   Simplified business models; external and secure financing; linking end-users to financial institutions; maintenance contracts; ensure income
3. **Political support and regulation**
   Clear regulatory frameworks; involve government/ministries/local authorities in all stages;
4. **Project management**
   Clear allocation of tasks between partners; transparent, experienced and strong management; progress monitoring; clear ownership AV system

Conclusion

The are many challenges: however, they can be addressed!

Risks associated with agrivoltaics might go beyond those of other RE projects

- Additional dimension of agriculture affects wider social practices of individuals and communities
- Integrated agrivoltaic systems including additional energy services add complexity to planning, implementation and long-term functioning of technical equipment
- Increased complexity of agrivoltaic projects for community energy

BUT, if planned and implemented in a people-centered approach, agrivoltaics display a great potential to address the Water-Energy-Food Nexus.

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Project Partners

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Thank you for your attention!

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