GMI components and implementation (Dr. Arun Bhagat)

Group micro-irrigation (GMI) (India)

DESCRIPTION

The group micro-irrigation (GMI) approach encourages farmers to share water more sustainably by facilitating cooperative management of irrigation resources. The aim is to improve water security and agricultural productivity by promoting climate-resilient agricultural practices and addressing the behavioural factors that influence water resource sharing.

The group micro-irrigation (GMI) approach encourages farmers to share water more sustainably by facilitating cooperative management of irrigation resources in semi-arid regions. The aim is to improve water security and agricultural productivity by promoting climate-resilient agricultural (CRA) practices and addressing the behavioural factors that influence water resource sharing. By treating water as a shared community resource rather than private property, GMI promotes equitable distribution and sustainable use of limited water resources among farmers by organizing farmer groups and utilizing shared water management infrastructure.

The GMI approach is divided into four major components: (1) supply-side groundwater management to recharge and conserve water sources, (2) demand-side management via efficient micro-irrigation systems, (3) promotion of CRA practices to improve soil health, and (4) integration of applied research to develop tools that allow farmers to assess and improve their agricultural practices. These components aim to optimize water use, reduce crop production costs, and encourage farmer collaboration for shared resources and access to advanced agricultural technologies.

The primary objectives of the GMI approach are to improve water productivity, enhance crop yield, and reduce dependency on groundwater for irrigation, especially in regions facing water scarcity. Through group collaboration, the approach also aims to reduce individual investment costs for farmers, facilitate access to subsidies, and increase resilience to climate fluctuations. Additionally, by integrating CRA practices, GMI supports sustainable agricultural practices that contribute to long-term soil health and ecosystem stability.

The GMI approach involves several methods, including:

•Groundwater Management: rainwater harvesting and construction of soil and water conservation structures to replenish groundwater levels.

•Micro-Irrigation Systems: installation of shared drip and sprinkler irrigation systems that optimize water use and are accessible to all group members.

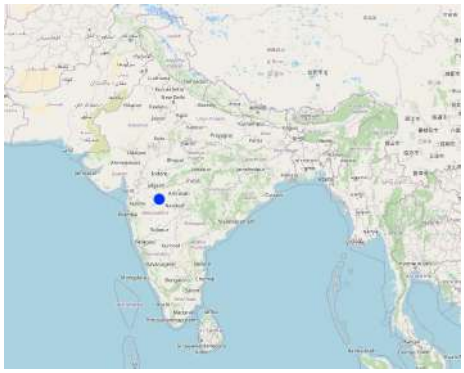
•CRA Practices: seed treatment, crop spacing, intercropping & trap cropping, applying farmyard manure (FYM), vermicompost, and organic waste compost, and making use of organic inputs, Bio-pest management practices including the use of pheromone traps, light traps, and bio-pesticides.

•Applied Research: use of tools like crop water budgeting, groundwater testing, and field book record-keeping, enabling farmers to make data-driven decisions.

The implementation of GMI involves four stages:

•Planning and Assessment: identifying suitable villages, farmer groups, and available water resources. Farmers with similar irrigation needs are grouped based on geographic proximity

LOCATION



Location: Tigalkheda, Bhokardan Block, state: Maharashtra, India

Geo-reference of selected sites

- 75.86684, 20.118

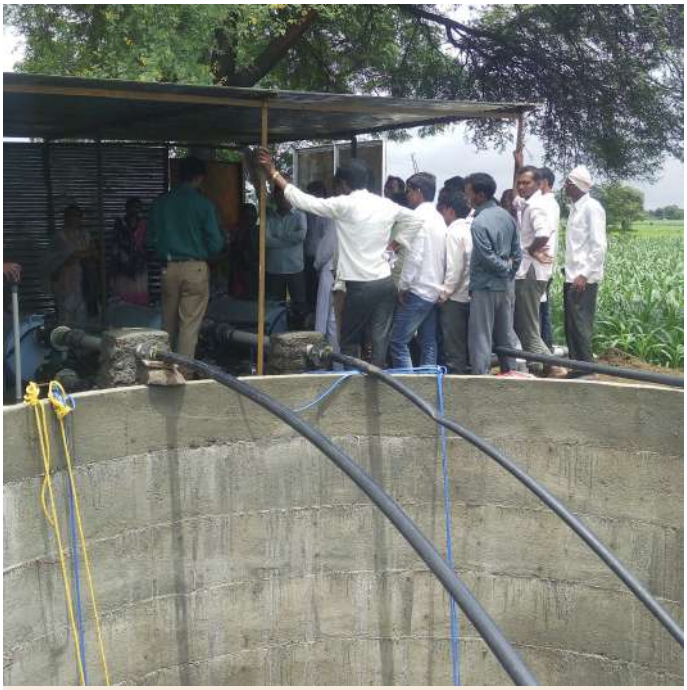
Initiation date: 2017

Year of termination: n.a.

Type of Approach

- ☐ traditional/ indigenous
- ☐ recent local initiative/ innovative
- ☑ project/ programme based

and water source access.
•Infrastructure Development: establishing common irrigation systems and water conservation structures, including dug wells, check dams, and pipelines.
•Training and Capacity Building: educating farmers on CRA practices, irrigation management, and using applied research tools for decision-making.
•Monitoring and Evaluation: regular assessment of crop and water productivity, adjustment of practices based on field data, and continuous training to ensure sustainability.
The GMI approach involves a range of stakeholders:
•Farmers: key participants who manage day-to-day operations, share resources, and implement CRA practices.
•Watershed Organisation Trust (WOTR): the primary implementing organization, providing technical support, training, and ongoing assessment.
•Local Government: supports funding for infrastructure, provides access to subsidies, and helps promote CRA practices.
•Agricultural Experts and Researchers: developing tools for applied research and supporting data analysis to improve productivity and water efficiency.
Farmers value the GMI approach for a variety of reasons, including lower individual investment, access to reliable water resources, and increased crop productivity. The cooperative aspect has strengthened community bonds and ensured equal access to resources. However, some farmers were initially hesitant to share water resources and bear the upfront costs of micro-irrigation systems. These concerns faded as the benefits of increased productivity and resource efficiency became clear.


Stakeholders interacting with each other (Dr. Arun Bhagat)

Farmers understanding the GMI approch (Dr. Arun Bhagat)

APPROACH AIMS AND ENABLING ENVIRONMENT

Main aims / objectives of the approach

The primary goal of the GMI approach is to boost agricultural productivity by ensuring consistent irrigation access, particularly in water-scarce areas. It focuses on improving water use through shared micro-irrigation systems, ensuring efficient and equitable resource distribution among farmers. Furthermore, the approach encourages climate-resilient practices that improve soil health and crop resilience, allowing farmers to adapt to climate variability. By encouraging collaboration within farming communities, GMI creates a cooperative framework for sharing resources and lowering individual costs. Finally, it seeks to improve rural sustainability by reducing production costs, increasing income stability, and promoting food security.

Conditions enabling the implementation of the Technology/ ies applied under the Approach

- **Social/ cultural/ religious norms and values**: Community cooperation and shared values regarding resource management help in collaboration among farmers.
- **Availability/ access to financial resources and services**: Access to microfinance or government subsidies supported the initial investment.
- **Institutional setting**: Support from NGO and agricultural institutions provides technical assistance and training.
- **Collaboration/ coordination of actors**: Strong collaboration among farmers, NGOs, and local authorities enhances resource sharing and knowledge transfer.
- **Legal framework (land tenure, land and water use rights)**: Water use rights were verbally stated
- **Policies**: Supportive government policies facilitate the implementation
- **Land governance (decision-making, implementation and enforcement)**: Local governance structures enhance the decision-making processes related to resource management.
- **Knowledge about SLM, access to technical support**: Availability of training programs and technical support helps farmers adopt best practices in micro-irrigation.
- **Markets (to purchase inputs, sell products) and prices**: Access to markets for selling produce encourages investment in improved irrigation methods
- **Workload, availability of manpower**: Availability of community labor facilitates the implementation of irrigation systems

Conditions hindering the implementation of the Technology/ ies applied under the Approach

PARTICIPATION AND ROLES OF STAKEHOLDERS INVOLVED

Stakeholders involved in the Approach and their roles

What stakeholders / implementing bodies were involved in the Approach?	Specify stakeholders	Describe roles of stakeholders
local land users/ local communities	The primary stakeholders of the GMI model. They contribute to decision-making and implementation processes related to the irrigation system	
SLM specialists/ agricultural advisers		Offer guidance on sustainable land management (SLM) practices and assist farmers in adopting climate-resilient agricultural techniques, ensuring effective use of the micro-irrigation system.
researchers		Researchers conduct studies to evaluate the effectiveness of the GMI model, focusing on behavioral aspects and mental models of farmers regarding water sharing. Their findings contribute to improving practices and informing policy decisions related to water management.
NGO	Watershed Organisation Trust, (WOTR) Pune	WOTR is the implementing NGO that provides technical support, training, and capacity-building initiatives for farmers. WOTR facilitate community engagement and help establish the GMI model as a sustainable water-sharing approach. WOTR also carried out impact analysis and research components of GMI approach
private sector		Providing materials, micro-irrigation system
national government (planners, decision-makers)		Promoted policies that support sustainable irrigation practices, such as the Pradhan Mantri Krishi Sinchai Yojana (PMKSY), which encourages micro-irrigation technologies across India. Provide subsidies for micro-irrigations
international organization	GIZ	Funding of the project

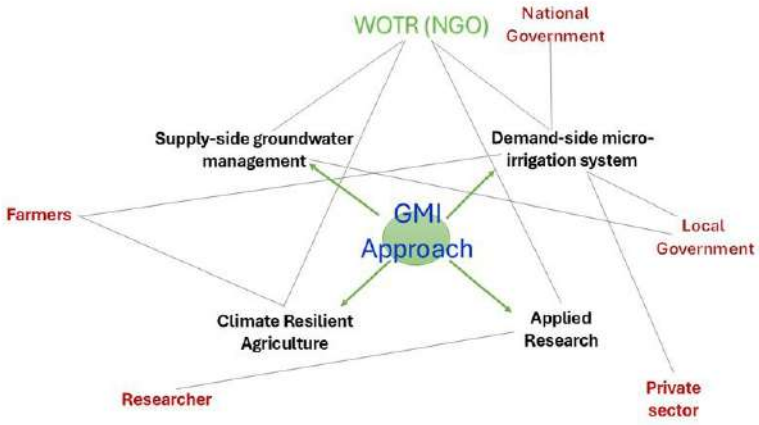
Lead agency
Watershed Organisation Trust, (WOTR) Pune

Involvement of local land users/ local communities in the different phases of the Approach

	none	passive	external support	interactive	self-mobilization	
initiation/ motivation				✓		Local farmers were actively engaged during the initiation phase, participating in discussions facilitated by the Watershed Organisation Trust (WOTR) to understand the benefits of the GMI model. They expressed their interest in sustainable water management practices
planning				✓		Farmers contributed to planning sessions where they identified their needs and preferences for irrigation practices. They collaborated with WOTR to outline the logistics of water sharing and resource management
implementation				✓		Local farmers played a crucial role in implementing the GMI model by assisting in the installation of irrigation infrastructure, such as drip systems and automation technologies. They also participated in de-silting the selected well to enhance its capacity for water storage
monitoring/ evaluation				✓		Farmers were involved in monitoring the effectiveness of the irrigation system and evaluating its impact on crop yields. They provided feedback on water usage, crop performance, and any challenges faced, allowing for adjustments to be made collaboratively with WOTR.
research				✓		Farmers participated in research activities aimed at better understanding their mental models of water sharing. They collaborated with researchers to provide insights into their experiences, beliefs, and attitudes towards cooperative water management practices under the GMI model.

Flow chart

Linking of GMI components with the stakeholders



Author: Pratik Ramteke

Decision-making on the selection of SLM Technology

Decisions were taken by

- [ ] land users alone (self-initiative)
- [ ] mainly land users, supported by SLM specialists
- [x] all relevant actors, as part of a participatory approach
- [ ] mainly SLM specialists, following consultation with land users
- [ ] SLM specialists alone
- [ ] politicians/ leaders

Decisions were made based on

- [x] evaluation of well-documented SLM knowledge (evidence-based decision-making)
- [x] research findings
- [x] personal experience and opinions (undocumented)

TECHNICAL SUPPORT, CAPACITY BUILDING, AND KNOWLEDGE MANAGEMENT

The following activities or services have been part of the approach

- [x] Capacity building/ training
- [x] Advisory service
- [x] Institution strengthening (organizational development)
- [x] Monitoring and evaluation
- [x] Research

Capacity building/ training

Training was provided to the following stakeholders

- [x] land users
- [x] field staff/ advisers

Form of training

- [x] on-the-job
- [x] farmer-to-farmer
- [x] demonstration areas
- [x] public meetings
- [ ] courses

Subjects covered

Water management practices, micro-irrigation systems installation, maintenance of drip irrigation, fertigation technologies, sustainable agricultural practices, climate-resilient farming techniques, cooperative management, collective decision-making and resource sharing among farmers.

Advisory service

Advisory service was provided

- [x] on land users' fields
- [x] at permanent centres

Institution strengthening

Institutions have been strengthened / established

- [ ] no
- [ ] yes, a little
- [ ] yes, moderately
- [x] yes, greatly

at the following level

- [x] local
- [x] regional
- [ ] national

Describe institution, roles and responsibilities, members, etc.

Type of support

- [x] financial
- [x] capacity building/ training
- [x] equipment

Further details

Monitoring and evaluation

Monitoring and evaluation are integral components of the GMI approach, for the assessment of its effectiveness in promoting sustainable water-sharing practices and improving agricultural productivity among local farmers.

Research

Research treated the following topics

- [x] sociology
- [x] economics / marketing
- [x] ecology
- [x] technology
- [x] Agriculture

Research was conducted by Miss. Upasana Koli, Dr. Arun Bhagat, and Dr. Marcella D'Souza from the Watershed Organisation Trust (WOTR). The focus of the research included understanding the mental models that promote water sharing for agriculture through the GMI approach. It examined behavioural aspects related to water resource management, cooperative practices among farmers, and the socio-economic impacts of adopting sustainable irrigation technologies. The findings aim to inform policymakers and practitioners about effective water-sharing policies and sustainable agricultural interventions.
Arun Bhagat: Contributed to the conceptualization, methodology design, investigation, data curation, formal analysis, original draft writing, and reviewing and editing of the manuscript.
Upasana Koli: Contributed to the conceptualization, methodology design, investigation, and data curation for the study.
Marcella D'Souza: Provided supervision and contributed to conceptualizing the research project.

FINANCING AND EXTERNAL MATERIAL SUPPORT

Annual budget in USD for the SLM component

- [ ] < 2,000
- [x] 2,000-10,000
- [ ] 10,000-100,000
- [ ] 100,000-1,000,000
- [ ] > 1,000,000

Precise annual budget: n.a.

The annual budget varies between 2000-10000 US$. GIZ acts as a core funder, primarily supporting project design, monitoring, and capacity-building activities. However, co-funding comes from various sources: 1.State Government: Provides subsidies for micro-irrigation systems and infrastructure, such as those under the Pradhan Mantri Krishi Sinchayee Yojana (PMKSY). 2.WOTR: Contributes technical expertise, facilitates training, and monitors implementation, often covering operational costs. 3.Farmers: Contribute funds for system maintenance and may also pool resources for initial installations. Regarding training, WOTR plays a pivotal role, offering on-field demonstrations and workshops on water management, climate-resilient agriculture, and system maintenance. Farmers benefit from continuous knowledge sharing and capacity-building initiatives. •Tigalkheda is a semi-arid village in Maharashtra's Bhokardan block, spanning approximately 32.34 acres, as mentioned in the documentation. •The GMI approach involves 14 farmers, all managing plots within this shared irrigation system. •Further, within a single village several GMI models can be created based on the farmer groups.

The following services or incentives have been provided to land users

- [x] Financial/ material support provided to land users
- [x] Subsidies for specific inputs
- [x] Credit
- [x] Other incentives or instruments

Financial/ material support provided to land users

Support: Farmers received subsidies for the installation of micro-irrigation systems and installation of the pumping system and pipe distribution network. Condition: The farmer should be a member of the GMI group and ready to contribute financially to maintaining the GMI model.
Providers: Government Bodies: Local and national government (Pradhan Mantri Krishi Sinchai Yojana (PMKSY); Partial funding from GIZ; Knowledge & implementation support by WOTR.

	partly financed	fully financed
labour labor costs related to the installation of irrigation systems.	✓	
equipment: tools Drip irrigation system		✓

agricultural: seeds National government subsidies	✓
agricultural: seeds: fertilizers National government subsidies	✓
construction: stone	✓
Cement, steel Dug-well development	✓

Labour by land users was

- [x] voluntary
- [ ] food-for-work
- [ ] paid in cash
- [ ] rewarded with other material support

Credit

Conditions: Interest rate: 8.3 to 10.1%, payback period: NA
Credit providers: Banks, Private lenders,
Credit receivers: Farmers

Other incentives or instruments

Supporting Policies: Government policies such as the Pradhan Mantri Krishi Sinchai Yojana (PMKSY) provide financial assistance for micro-irrigation technologies

IMPACT ANALYSIS AND CONCLUDING STATEMENTS

Impacts of the Approach

	No	Yes, little	Yes, moderately	Yes, greatly
Did the Approach empower local land users, improve stakeholder participation? GMI developed a sense of ownership among farmers, leading to increased involvement in decision-making processes related to water management				✓
Did the Approach enable evidence-based decision-making? Training sessions and workshops provided farmers with the knowledge needed to make informed decisions about irrigation practices				✓
Did the Approach help land users to implement and maintain SLM Technologies? Farmers received hands-on training and technical support, enabling them to effectively implement micro-irrigation systems.				✓
Did the Approach improve coordination and cost-effective implementation of SLM? The cooperative model promoted collaboration among farmers, leading to more efficient resource use				✓
Did the Approach mobilize/ improve access to financial resources for SLM implementation? Subsidies and credit options facilitated financial access for farmers adopting new technologies			✓	
Did the Approach improve knowledge and capacities of land users to implement SLM? Continuous training enhanced farmers' skills in sustainable agricultural practices				✓
Did the Approach improve knowledge and capacities of other stakeholders? NGOs and local government bodies benefited from increased understanding of sustainable practices through their engagement in the project				✓
Did the Approach build/ strengthen institutions, collaboration between stakeholders? The GMI model strengthened local farmer groups and enhanced collaboration with NGOs.				✓
Did the Approach mitigate conflicts? The shared water management approach reduced competition for resources among farmers.				✓
Did the Approach empower socially and economically disadvantaged groups? The project specifically targeted small and marginal farmers, providing them with resources and support				✓
Did the Approach improve gender equality and empower women and girls? Women participated in training sessions, enhancing their roles in agricultural decision-making.				✓
Did the Approach encourage young people/ the next generation of land users to engage in SLM? Training and awareness campaigns have sparked interest among younger generations in sustainable farming practices.				✓
Did the Approach improve issues of land tenure/ user rights that hindered implementation of SLM Technologies? The project addressed rights issues by promoting Community driver visual indicator (CDVI) tool				✓
Did the Approach lead to improved food security/ improved nutrition? Enhanced irrigation practices have resulted in better crop yields, contributing to food security				✓

Did the Approach improve access to markets?
By connecting the farmers with the local Farmers Produce Organisation (FPO) and market

Did the Approach lead to improved access to water and sanitation?
Efficient water management has improved overall access to water resources for agricultural and domestic use.

Did the Approach lead to more sustainable use/ sources of energy?
Adoption of efficient irrigation systems has encouraged sustainable energy practices among farmers

Did the Approach improve the capacity of the land users to adapt to climate changes/ extremes and mitigate climate related disasters?
By efficient water management practices and promoting climate resilient agricultural practices

Did the Approach lead to employment, income opportunities?
Increased agricultural productivity has created additional income sources for farmers.

Main motivation of land users to implement SLM

- [x] increased production
- [x] increased profit(ability), improved cost-benefit-ratio
- [x] reduced land degradation
- [ ] reduced risk of disasters
- [x] reduced workload
- [ ] payments/ subsidies
- [ ] rules and regulations (fines)/ enforcement
- [ ] prestige, social pressure/ social cohesion
- [ ] affiliation to movement/ project/ group/ networks
- [ ] environmental consciousness
- [ ] customs and beliefs, morals
- [x] enhanced SLM knowledge and skills
- [ ] aesthetic improvement
- [ ] conflict mitigation

Sustainability of Approach activities

Can the land users sustain what hat been implemented through the Approach (without external support)?

- [ ] no
- [x] yes
- [ ] uncertain

Farmers in Tigalkheda have developed a strong sense of ownership over the GMI approach. They have gained valuable knowledge and skills through training sessions provided by WOTR, enabling them to manage irrigation systems effectively. The cooperative structure established among local farmers facilitates resource sharing and collective decision-making, ensuring that they can maintain the technologies implemented. Additionally, the financial support received through subsidies has alleviated initial investment burdens, allowing farmers to sustain operations independently over time. This sustainability is further supported by the ongoing commitment of farmers to engage in sustainable agricultural practices, as they recognize the long-term benefits of improved water management and crop productivity for their livelihoods and the environment.

CONCLUSIONS AND LESSONS LEARNT

Strengths: land user's view

- 1) Improved Water Management
  Farmers appreciate the effective management of water resources through the GMI which allows for better distribution and utilization of water, leading to enhanced crop yields.
- 2) Increased Crop Productivity
  The implementation of micro-irrigation technologies has resulted in higher agricultural output, which is crucial for the livelihoods of local farmers.
- 3) Community Collaboration
  The approach promotes cooperation and shared responsibility in managing irrigation resources.
- 4) Access to Financial Support
  Availability of subsidies and financial assistance has made it easier for farmers to adopt new technologies, reducing the economic burden of transitioning to sustainable practices.

Strengths: compiler's or other key resource person's view

- 1) Sustainability of Practices
  The GMI approach emphasizes sustainable agricultural practices that enhance long-term resilience against climate variability and water scarcity.
- 2) Capacity Building
  Training programs have significantly improved the skills and knowledge of farmers, enabling them to implement and maintain sustainable land management technologies effectively.
- 3) Access to Market Information
  Farmers were connected with the Farmer Producing Organisation (FPO) for accessing timely market information.
- 4) Reduction in Conflicts Over Water Resources
  By establishing clear water-sharing agreements among users, the GMI model has reduced competition and conflicts over water resources in the community

Weaknesses/ disadvantages/ risks: land user's viewhow to overcome

- 1) Initial Costs of Technology Implementation
  While subsidies help, some farmers still find the initial costs of installing micro-irrigation systems prohibitive Increased awareness about available financial assistance and community pooling of resources could help mitigate these costs.
- 2)Maintenance Challenges
  Some farmers lack the technical skills needed for ongoing maintenance of irrigation systems. Regular training sessions focused on maintenance skills can empower farmers to manage their systems effectively.
- 3) Dependence on Weather Conditions
  The success of irrigation practices is still heavily reliant on overall weather patterns, which can be unpredictable. Implementing rainwater harvesting techniques alongside micro-irrigation could provide additional water security during dry spells.

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's viewhow to overcome

- 1) Scalability Issues
  The GMI model may face challenges in scaling up due to varying local conditions across different regions. Tailoring approaches to specific local contexts while maintaining core principles could enhance scalability.
- 2) Sustainability of Financial Support
  There is uncertainty regarding the long-term availability of subsidies and financial support from government programs. Advocating for policy changes that ensure sustained funding for sustainable agriculture initiatives could address this issue.
- 3) Cultural Resistance to Change
  Some farmers may resist adopting new technologies due to traditional practices. Engaging community leaders and demonstrating successful case studies can help shift perspectives towards embracing innovation.
- 4) Limited Research on Long-Term Impacts
  There is a need for more comprehensive research on the long-term impacts of the GMI approach on both agricultural productivity and environmental sustainability. Collaborating with

academic institutions for ongoing research projects can provide valuable insights into effectiveness and areas for improvement

REFERENCES

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Date of documentation: Nov. 18, 2024

Last update: Nov. 29, 2024

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Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/approaches/view/approaches_7415/

Linked SLM data
n.a.

Documentation was faciliated by

Institution
- Watershed Organisation Trust (WOTR) (Watershed Organisation Trust (WOTR)) - India

Project
- n.a.

Key references
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Links to relevant information which is available online
- Climate-resilient strategies for sustainable management of water resources and agriculture: https://link.springer.com/article/10.1007/s11356-021-14332-4
- Economics, adoption determinants, and impacts of micro-irrigation technologies: empirical results from India: https://link.springer.com/article/10.1007/s00271-007-0065-0

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