

BLOCKCHAIN IN AGRICULTURE – ENHANCING FOOD TRACEABILITY

Implementation of Smart Contract
Deployment using Solidity,
MetaMask and Ganache

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D17B / 2

Problem Statement



- Traditional agricultural supply chains rely on centralized records, which are:
- Prone to tampering, loss, or human error
- Lack of transparency for consumers
- Delay identification of contamination sources or fraud
- No unified platform exists for tracing the journey of food products from farm to consumer.

PROPOSED SOLUTION

• • •

Implement a Blockchain-based Food Traceability System that:

- Records every step of the food journey (harvest, transport, storage, sale)
- Uses Smart Contracts to automate registration and tracking
- Ensures immutability, transparency, and trust among stakeholders.

SIGNIFICANCE OF BLOCKCHAIN

• • •

➤ Transparency

Everyone in the supply chain can verify data in real-time.

➤ Immutability

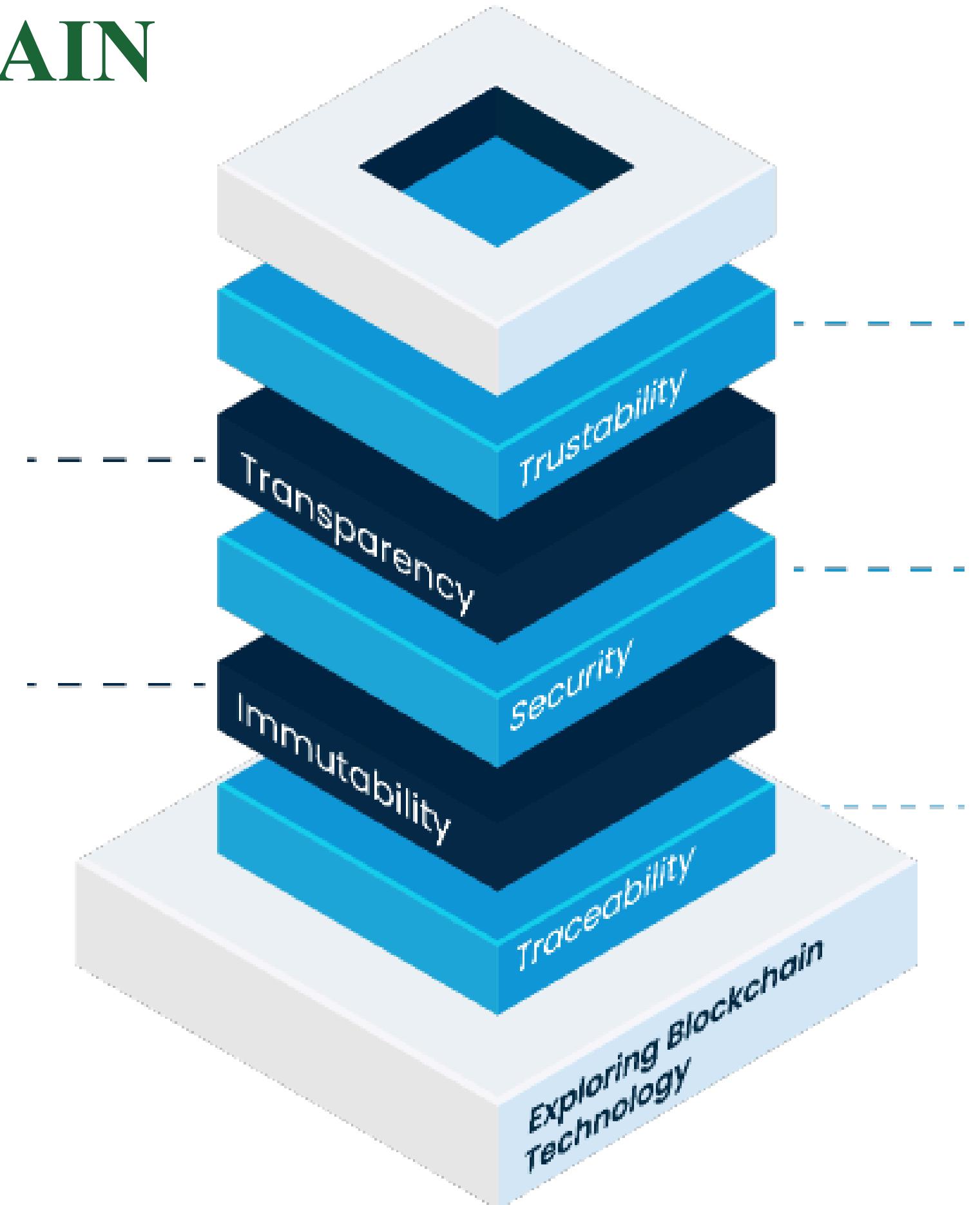
Once recorded, data cannot be altered.

➤ Automation

Smart contracts execute predefined rules without intermediaries.

➤ Trustless System

Removes need for central authority or manual verification.



KEY STAKEHOLDERS INVOLVED

...

Farmer

Producer

Registers product details (name, date, harvest location) via FoodRegistration.sol

Distributor

Transporter

Updates product movement and logistics via FoodTraceability.sol

Retailer

Seller

Updates storage and quality details via FoodTraceability.sol

Consumer

End-user

Can verify authenticity, source, and product journey by reading blockchain data.

SMART CONTRACTS INVOLVED

• • •

FoodRegistration.sol

- Purpose: Register products by farmers.
- Key Functions: registerProduct(),
getProduct()
- Data Stored: Product ID, Name,
Farmer, Harvest Date, Location

FoodTraceability.sol

- Purpose: Track product journey after registration.
- Key Functions: updateTrace(),
getTrace()
- Data Stored: Product ID, Distributor,
Transport Date, Retailer, Quality Check

IMPLEMENTATION OF EXP 6



Transactions recorded 4 i >

Deployed Contracts 2

FOODREGISTRATION AT 0xD9

Balance: 0 ETH

REGISTERPRODUCT

_name: Rice Batch 1

_farmerName: Farmer A

_harvestDate: 2024-09-27

_location: Village X

Calldata Parameters **transact**

GETPRODUCT

_id: 1

Calldata Parameters **call**

This screenshot shows the Truffle UI interface. On the left, there's a sidebar with icons for accounts, deployed contracts, and other blockchain-related functions. The main area displays two contracts: 'FOODREGISTRATION AT 0xD9' and 'REGISTERPRODUCT'. The 'REGISTERPRODUCT' contract has four transactions recorded. Below these, there are sections for 'GETPRODUCT' with an ID of 1 and a 'Calldata' button, and another 'GETPRODUCT' section with a 'Parameters' button.

GETPRODUCT

_id: 1

Calldata Parameters **call**

0: tuple(uint256,string,string,string,string): 1,Rice Batch 1,Farmer A,2024-09-27,Village X

productCount

0: uint256: 1

PRODUCTS

: 1

Calldata Parameters **call**

0: uint256: id 1

1: string: name Rice Batch 1

2: string: farmerName Farmer A

3: string: harvestDate 2024-09-27

4: string: location Village X

This screenshot shows the details of a registered product. It includes a 'GETPRODUCT' section with an ID of 1 and a 'Calldata' button. Below it is a 'PRODUCTS' section with a value of 1. The product details are listed as a tuple: (1, "Rice Batch 1", "Farmer A", "2024-09-27", "Village X"). Below this, there's a 'productCount' section showing a value of 1. At the bottom, there's a 'Calldata' button.

FOODTRACEABILITY AT 0xD8E

Balance: 0 ETH

UPDATETRACE

_productId: 1

_distributor: Distributor B

_transportDate: 2024-09-28

_retailer: Retailer C

_qualityCheck: Good

Calldata Parameters **transact**

GETTRACE

_productId: 1

Calldata Parameters **call**

This screenshot shows the details of a traced product. It includes a 'FOODTRACEABILITY AT 0xD8E' section with a balance of 0 ETH. Below it is an 'UPDATETRACE' section with fields for product ID (1), distributor (Distributor B), transport date (2024-09-28), retailer (Retailer C), and quality check (Good). There is a 'transact' button instead of a 'call' button. At the bottom, there's a 'GETTRACE' section with a product ID of 1 and a 'Calldata' button.

GETTRACE

_productId: 1

Calldata Parameters **call**

0: tuple(uint256,string,string,string,string): 1,Distributor B,2024-09-28,Retailer C,Good

TRACES

: 1

Calldata Parameters **call**

0: uint256: productId 1

1: string: distributor Distributor B

2: string: transportDate 2024-09-28

3: string: retailer Retailer C

4: string: qualityCheck Good

This screenshot shows the traces of a traced product. It includes a 'GETTRACE' section with a product ID of 1 and a 'call' button. Below it is a 'TRACES' section with a value of 1. The trace details are listed as a tuple: (1, "Distributor B", "2024-09-28", "Retailer C", "Good"). Below this, there's a 'Calldata' button.

FoodRegistration.sol

FoodTraceability.sol

IMPLEMENTATION OF EXP 7



Steps to get funds from RSK Testnet

1. In Metamask select, Add a new Test network
2. Add the following credentials

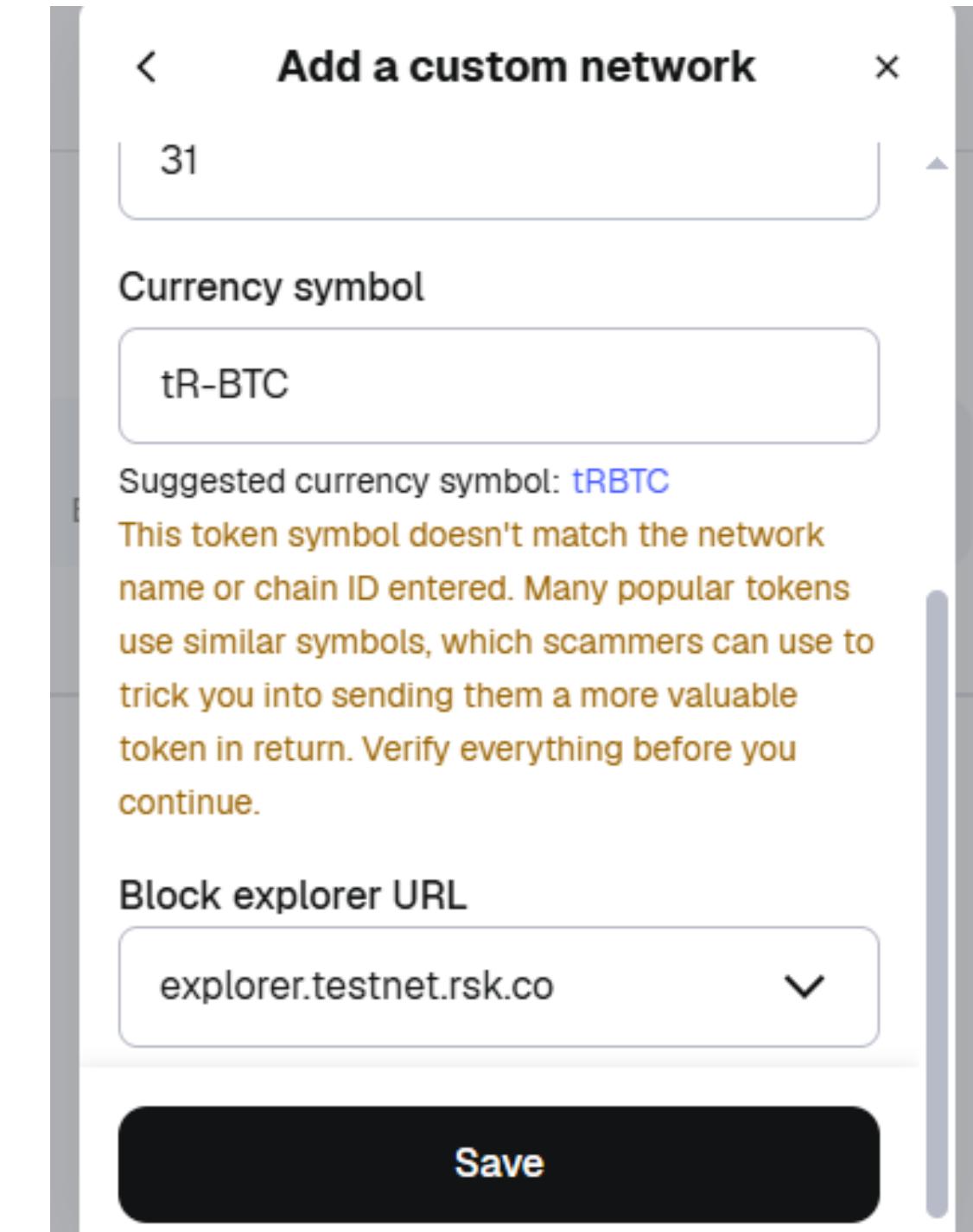
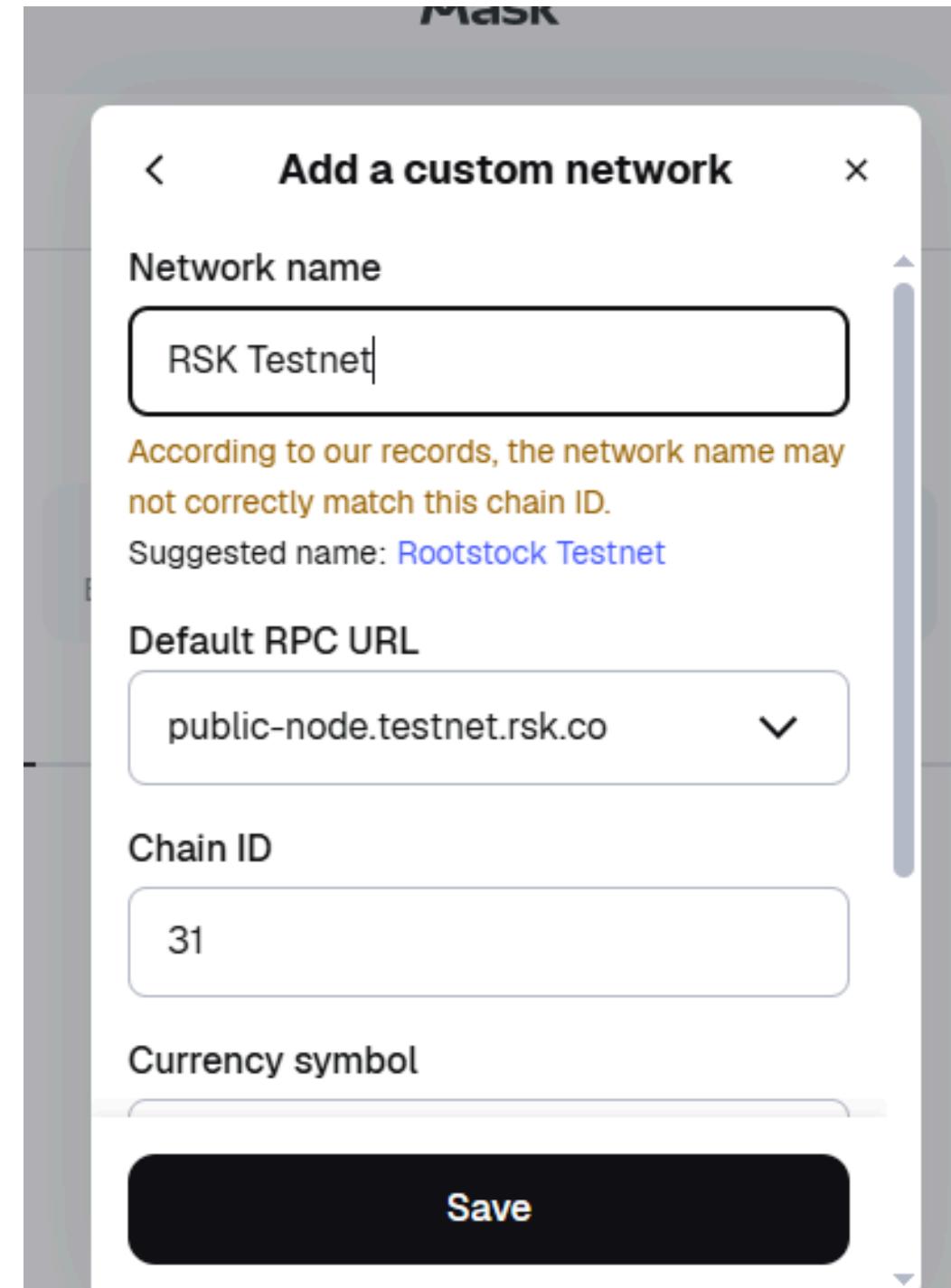
Network Name: RSK Testnet

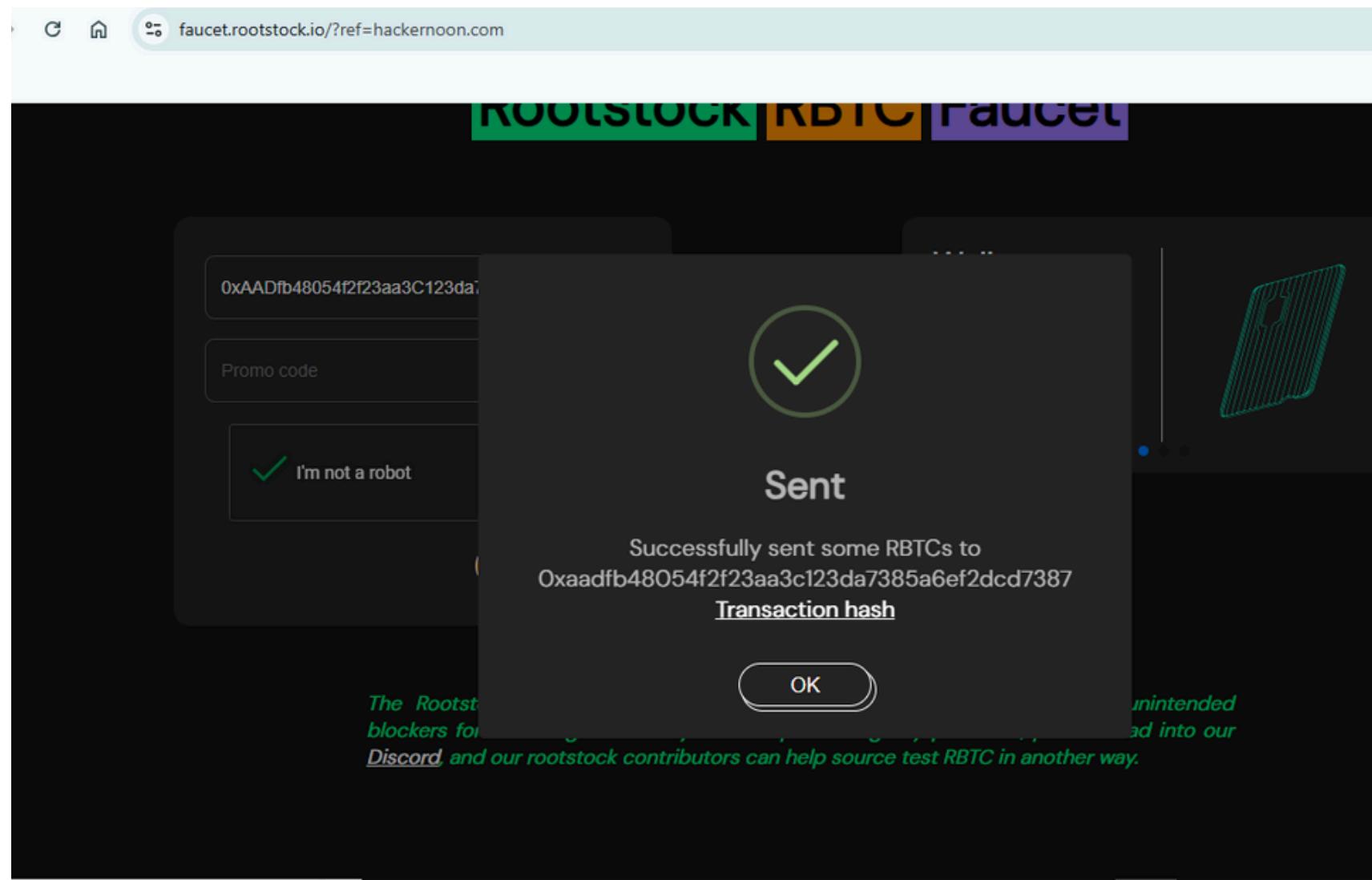
New RPC URL: <https://public-node.testnet.rsk.co>

ChainID (optional): 31

Symbol (optional): tR-BTC

Block Explorer URL (optional):
<https://explorer.testnet.rsk.co>





After the successful transfer of funds, check the transaction details @ RSK Testnet Explorer

Go to the RSK Testnet :
<https://faucet.rsk.co/?ref=hackernoon.com> and enter your account details from the Metamask to get free Ethers (only 0.05 RBTC per day)

A screenshot of a web browser showing the RSK Testnet Explorer. The URL in the address bar is 'explorer.testnet.rootstock.io/tx/0x12c8ffaa286f3d53e29cd83288d7d1ff500adacd3943127f5ed397c7ea9d315d'. The page has a dark theme. On the left, there's a sidebar with navigation links: Home, Blocks, Transactions (which is highlighted in purple), Addresses, Tokens, dApps, RAS, and Statistics. The main content area displays transaction details: Block: 6,869,428, Type: normal, Nonce: 61326, From: 0x88250F772101179a4EcFAA4b92a983676a3cE445, To: OxaadFb48054F2F23Aa3c123Da7385a6eF2DCd7387, Value: 0.0005 RBTC, Transaction Fee: 0.000001260000000 RBTC, Gas Price: 0.00000000006 RBTC (0.060000000 Gwei), Gas Used: 21,000, Input: 0x. There's also a 'Send Feedback' button at the bottom.

MetaMask chrome-extension://nkbihfbeogaeaoehlefknkodbefgpgknn/home.html#

The screenshot shows the MetaMask extension's home page. At the top, it displays "Account 1" with the address "0xAADfb..d7387". Below this, the balance is shown as "0.0005 TR-BTC" with a small circular icon next to it. A link "+\$0 (+0.00%) Discover" is present. Below the balance are four buttons: "Buy/Sell", "Swap", "Send", and "Receive". A horizontal navigation bar below these buttons includes tabs for "Tokens", "DeFi", "NFTs", and "Activity". The "Tokens" tab is selected. Under the "Tokens" tab, there is a dropdown menu set to "RSK Testnet" and a list item "tR-BTC" with a green upward arrow icon. To the right of the tokens section, there is a warning icon and the text "0.0005 tR-BTC".

Connect the RSK Testnet to Remix IDE

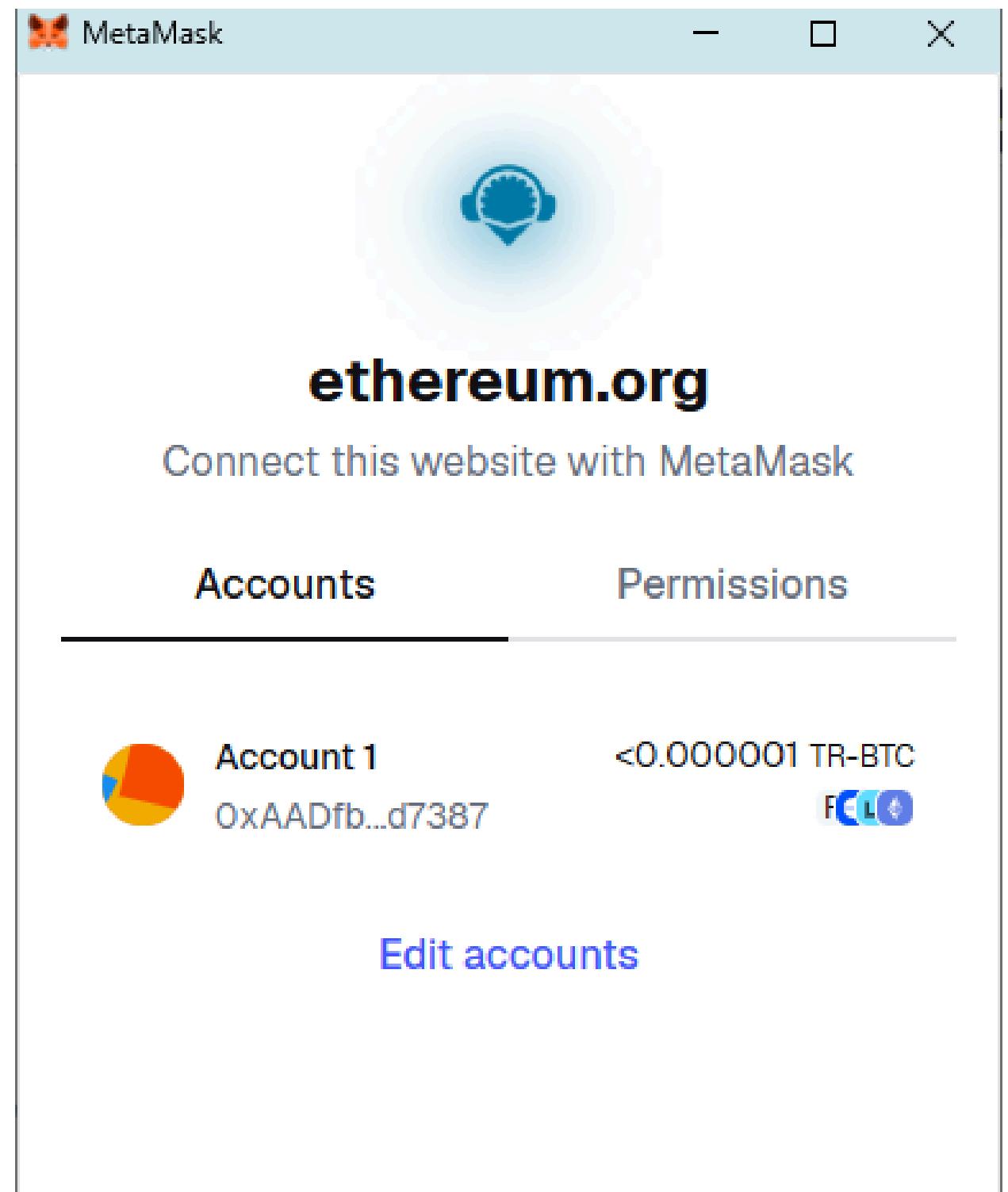
In the Remix IDE, select the Environment as Injected Web3.

The funds are available at Metamask

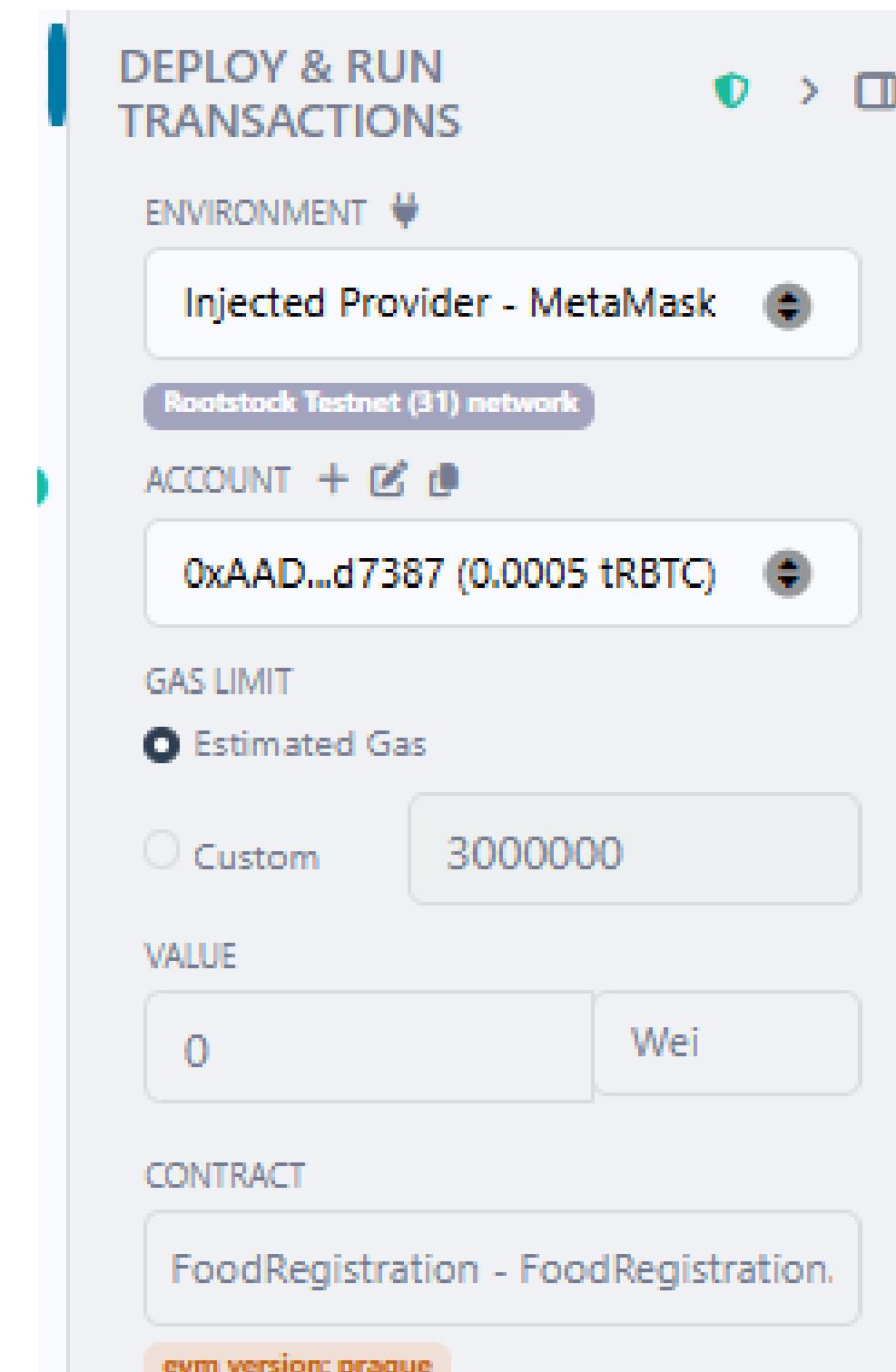
The screenshot shows the Remix IDE interface. The URL in the browser is "remix.ethereum.org/#lang=en&optimize=false&runs=20". On the left, there is a sidebar with various icons. In the center, under the heading "DEPLOY & RUN TRANSACTIONS", the "ENVIRONMENT" dropdown is open, showing a list of options. The option "Injected Provider - MetaMask" is highlighted with a dark blue background. On the right, the Solidity code for a "FoodRegistration" contract is displayed. The code defines a struct "Product" with fields "id", "name", "farmerName", "harvestDate", and "location". It also includes functions for deploying the contract and interacting with it using the injected provider.

```
// SPDX-License-Identifier: MIT
pragma solidity ^0.8.0;

contract FoodRegistration {
    struct Product {
        uint id;
        string name;
        string farmerName;
        string harvestDate;
        string location;
    }
}
```



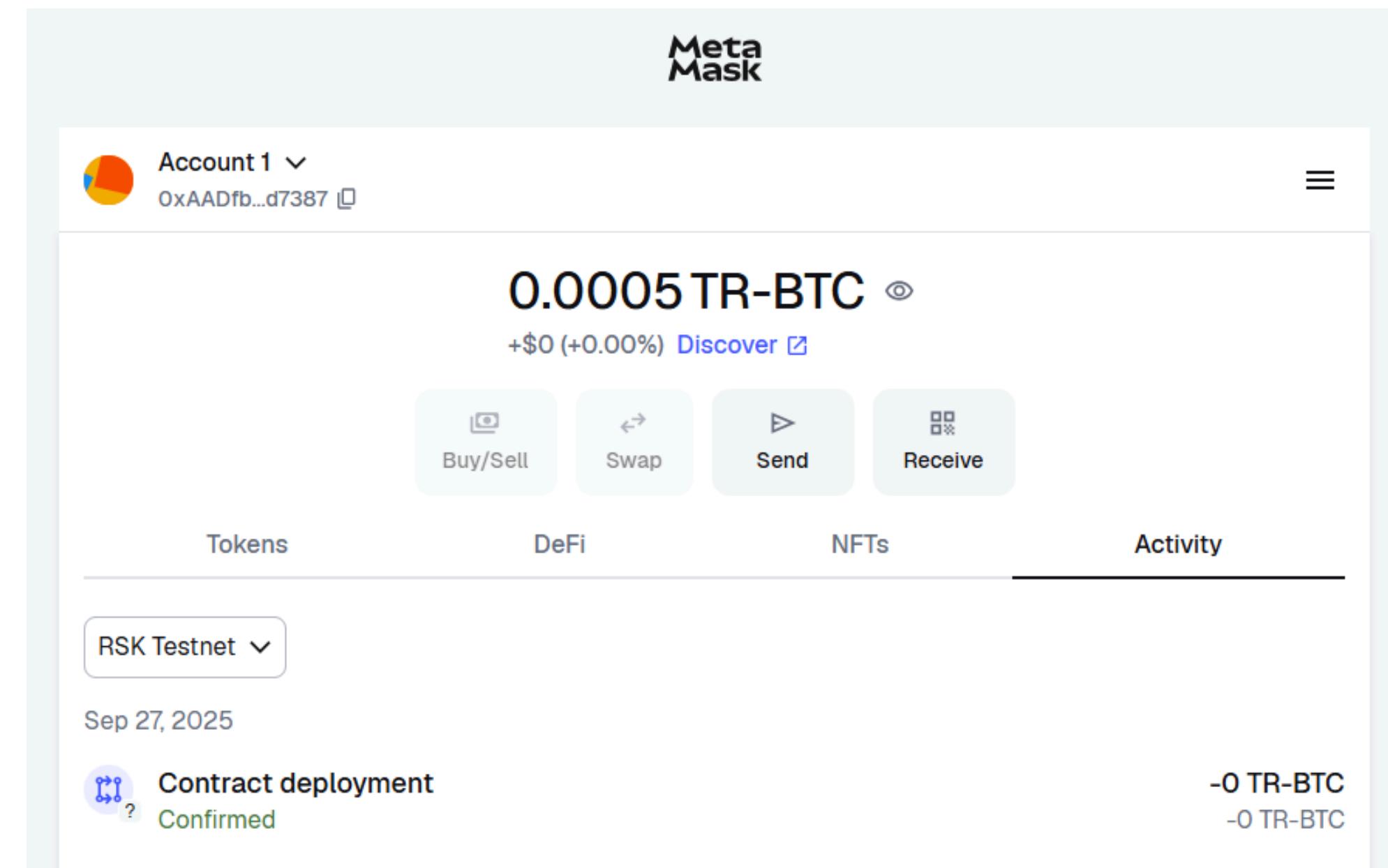
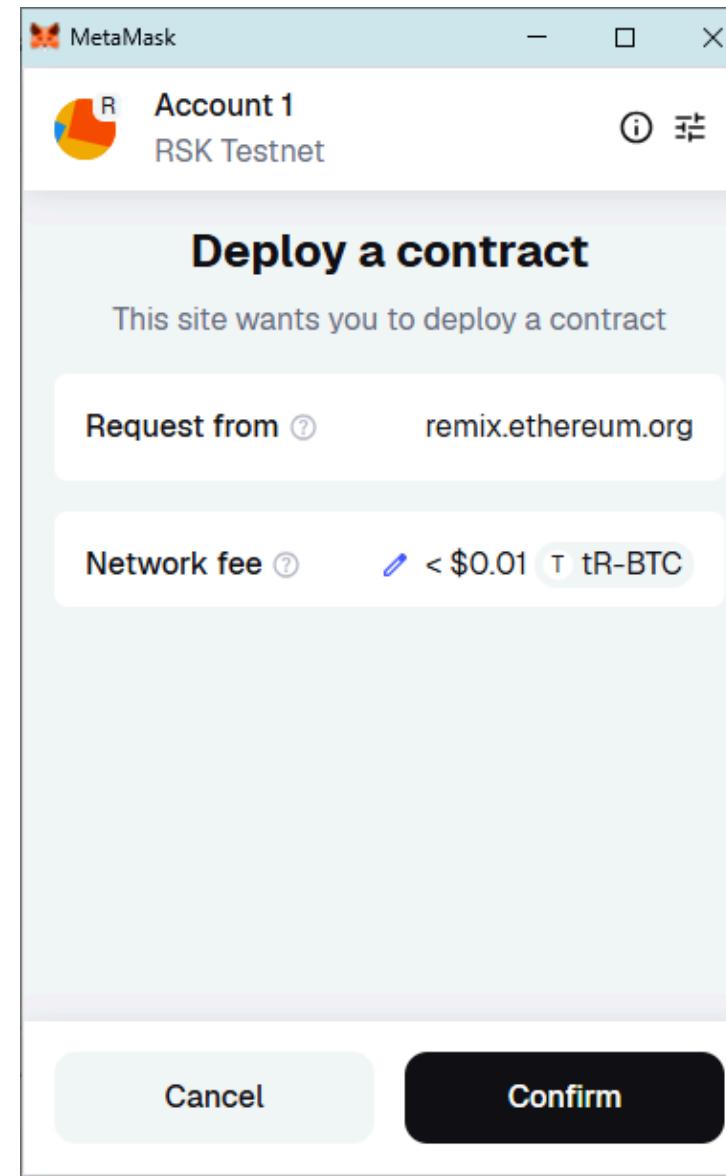
Once the Injected Web3 Provider is selected as Metamask, the following popup appears.



Click on Connect button. Once the Account is linked to Remix IDE, the Metamask Account details appears in the Deployment Environment as given

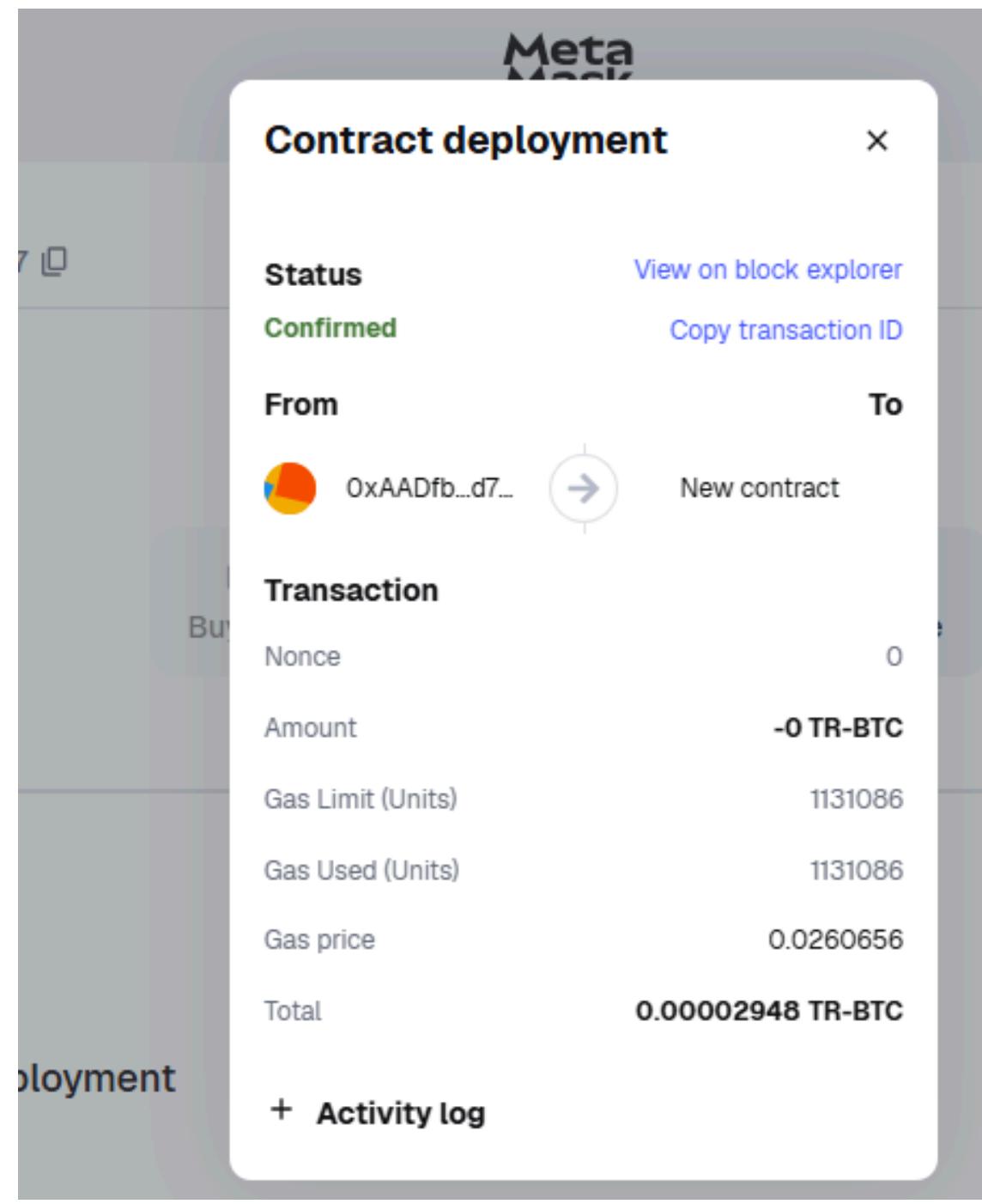
Create a Simple Solidity Smart Contract

FoodRegistration.sol



Compile and Deploy the Smart Contract.
Once the Contract is deployed on Remix IDE, the popup appears to confirm the Contract Deployment.

Once the transaction is confirmed the status of the transaction is displayed



Transaction Deployment details are displayed, w.r.t the Gas Limit, Used, Gas Used, Gas Price and Total Amount

The screenshot shows the Rootstock Testnet block explorer interface. The current view is the "Overview" tab for Block #6869511. Key details displayed include:

- RBTC Price: \$109,402.84 (+0.25%)
- Gas: \$0.060
- Need Gas?
- Block Number: 6,869,511
- Timestamp: 1m ago | Sep 27 2025 15:54:36 UTC
- Size: 8,483 bytes
- Transactions: 4 transactions in this block
- Miner: 0x905a918BA4e1c0eaA5e8186bDAc1BD786F9FOC8A

Check the transaction details on the RSK Explorer

1. Open <https://explorer.testnet.rsk.co/>
2. Enter the Block Hash / Transaction Hash on the Search. The details of the transactions are displayed as follows

RBTC Price: \$109,373.47 (+0.1%) Gas: \$0.057 Need Gas? [Add](#)

explorer.testnet.rootstock.io/tx/0x01a43e782871b660e5b2c20ecaa87d9698a74cac3aa0a143c0747fb08112ccc6

Transaction Details

[Overview](#) [Internal Transactions](#) [Logs](#) [Token Transfer](#)

[All transactions](#)

Address

Transaction Hash: 0x01a43e782871b660e5b2c20ecaa87d9698a74cac3aa0a143c0747fb08112ccc6

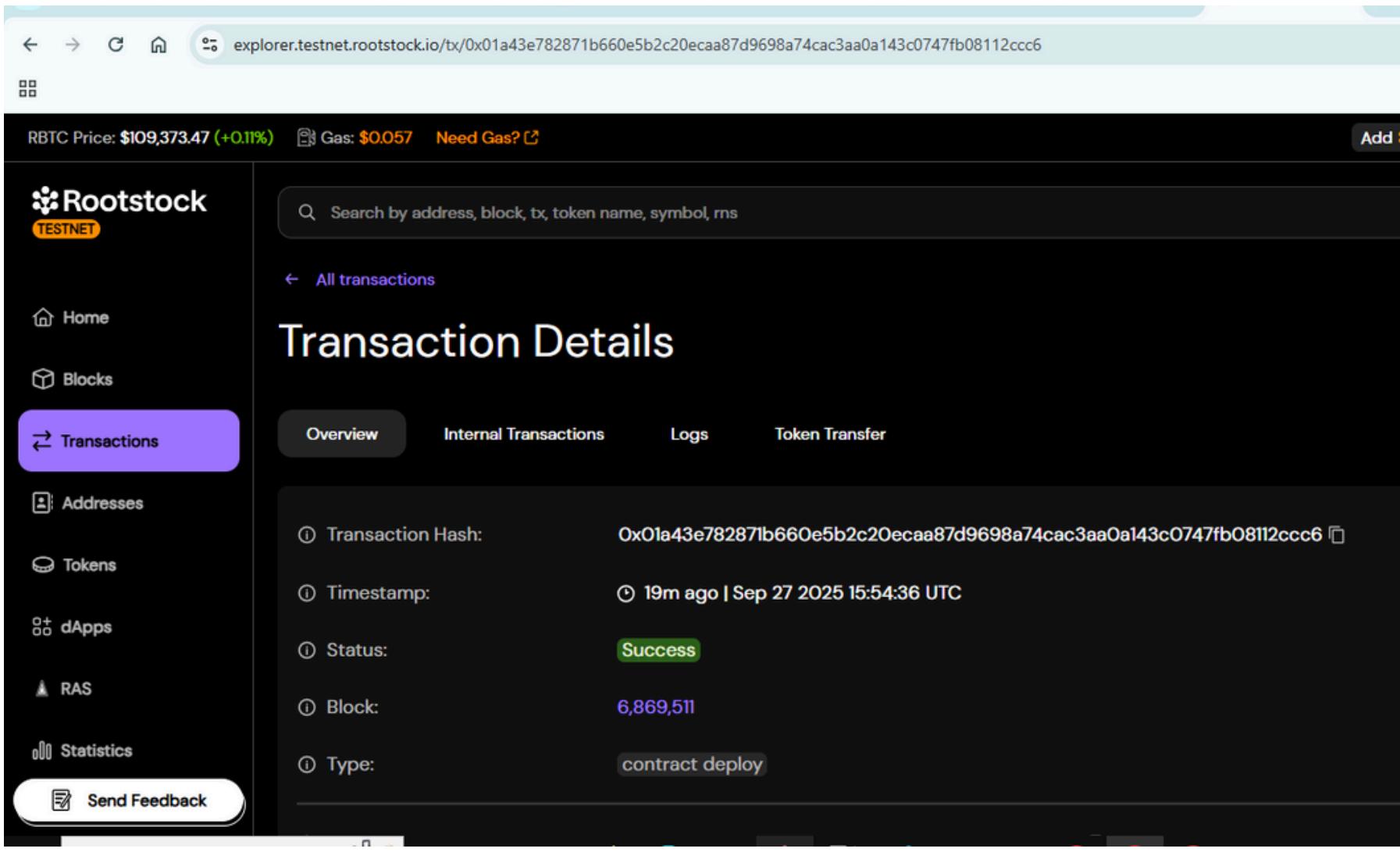
Timestamp: 19m ago | Sep 27 2025 15:54:36 UTC

Status: Success

Block: 6,869,511

Type: contract deploy

[Send Feedback](#)



Transaction Details

explorer.testnet.rootstock.io/tx/0x01a43e782871b660e5b2c20ecaa87d9698a74cac3aa0a143c0747fb08112ccc6

Transaction Details

Type: contract deploy

From: 0xaadFb48054F2F23Aa3c123Da7385a6eF2DCd7387

To: 0x830218D46F66Ce217727F2822705efa2FF8acB80

Value: 0 RBTC

Transaction Fee: 0.000029482435242 RBTC

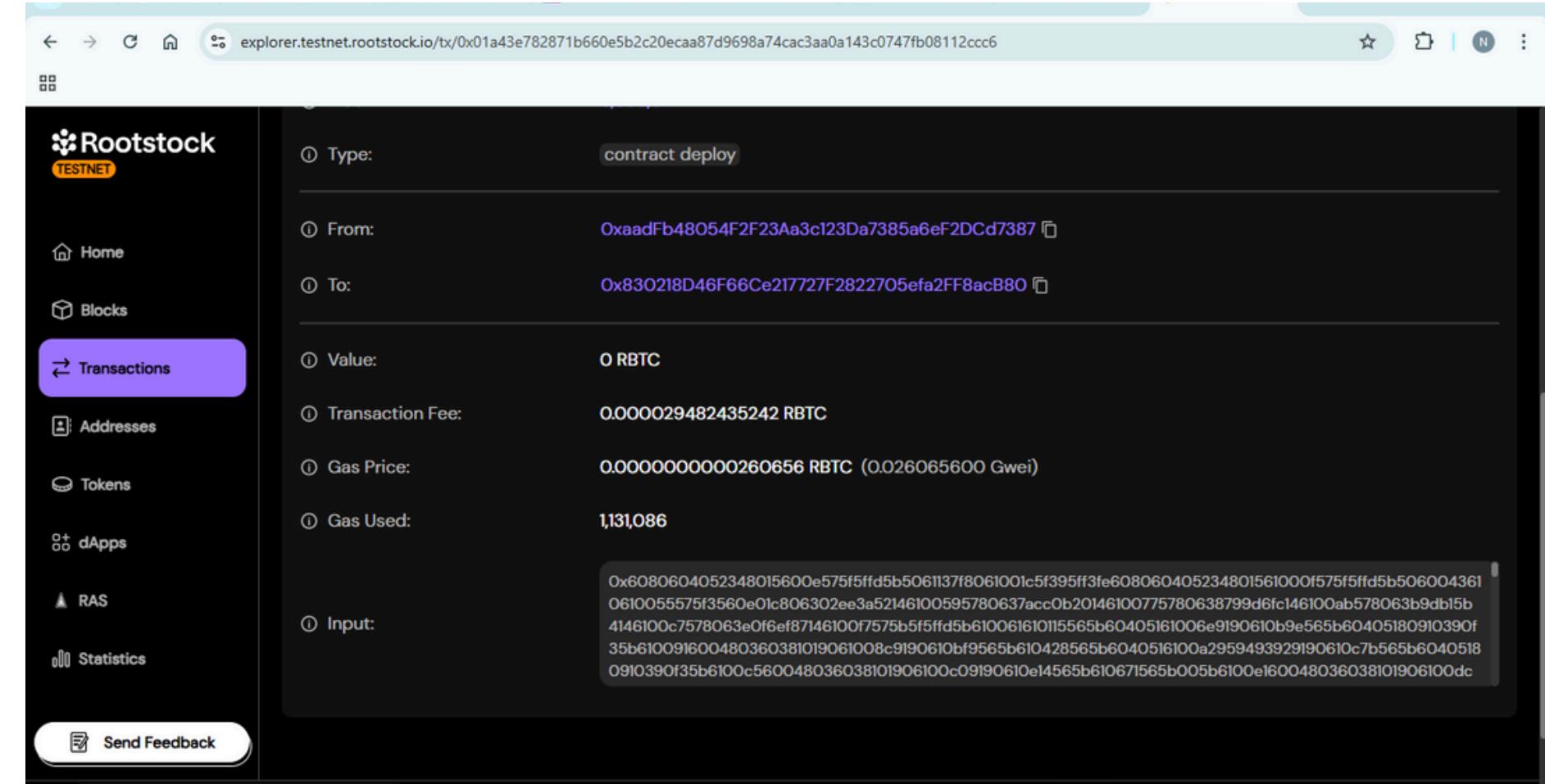
Gas Price: 0.0000000000260656 RBTC (0.026065600 Gwei)

Gas Used: 1,131,086

Input:

```
Ox6080604052348015600e575f5ffd5b5061137f8061001c5f395ff3fe608060405234801561000f575f5ffd5b506004361061005575f3560e01c806302ee3a52146100595780637acc0b20146100775780638799d6fc146100ab578063b9db15b4146100c578063e0f6ef87146100f757b5f5ffd5b610061610115565b60405161006e9190610b9e565b60405180910390f35b610091600480360381019061008c9190610bf9565b610428565b6040516100a2959493929190610c7b565b6040518910390f0910390f35b6100c560048036038101906100c09190610e14565b61067f1565b005b6100e160048036038101906100dc
```

[Send Feedback](#)



Deployed Contracts 1

FOODREGISTRATION AT 0X831

Balance: 0 ETH

REGISTERPRODUCT

_name: Rice Batch 1

_farmerName: Farmer A

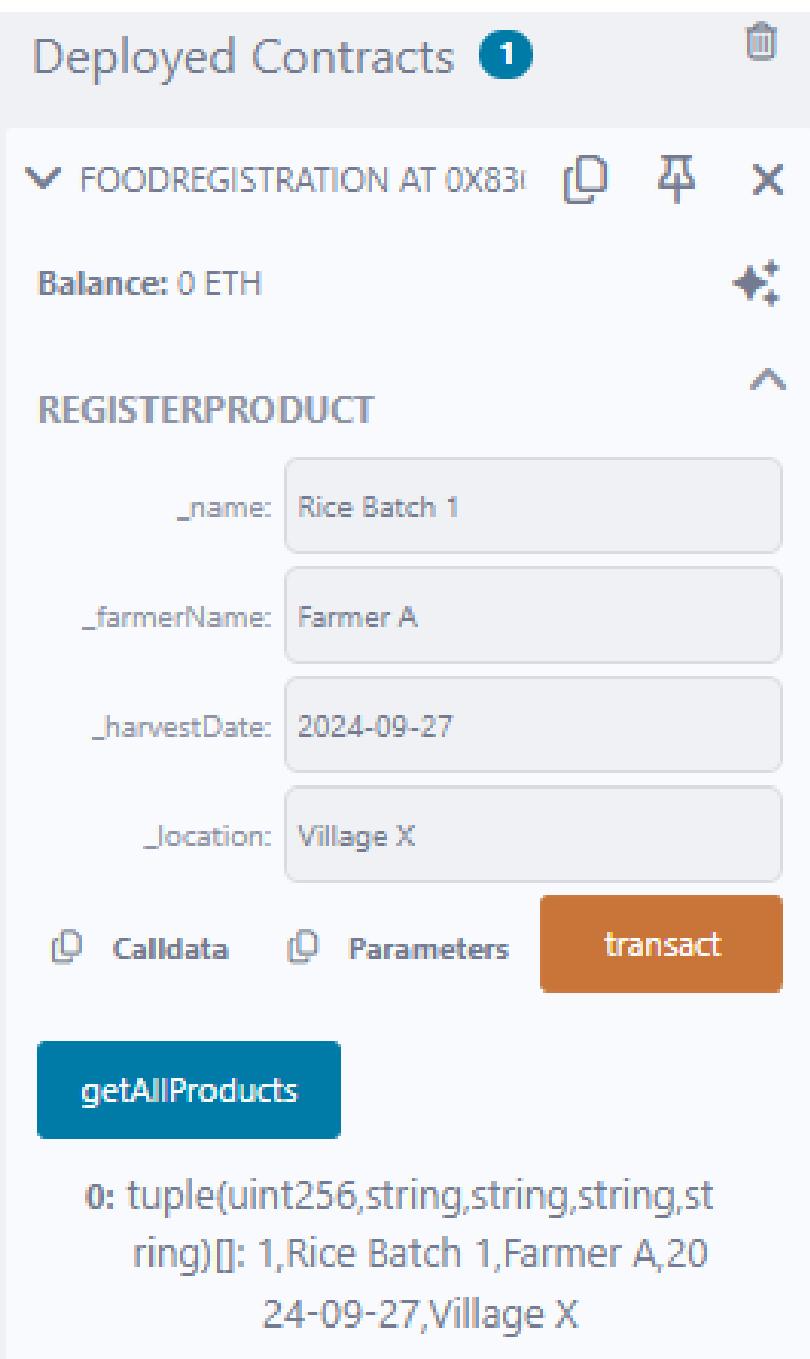
_harvestDate: 2024-09-27

_location: Village X

Calldata Parameters **transact**

getAllProducts

0: tuple(uint256,string,string,string,string)[]: 1,Rice Batch 1,Farmer A,2024-09-27,Village X



MetaMask

Account 1 RSK Testnet

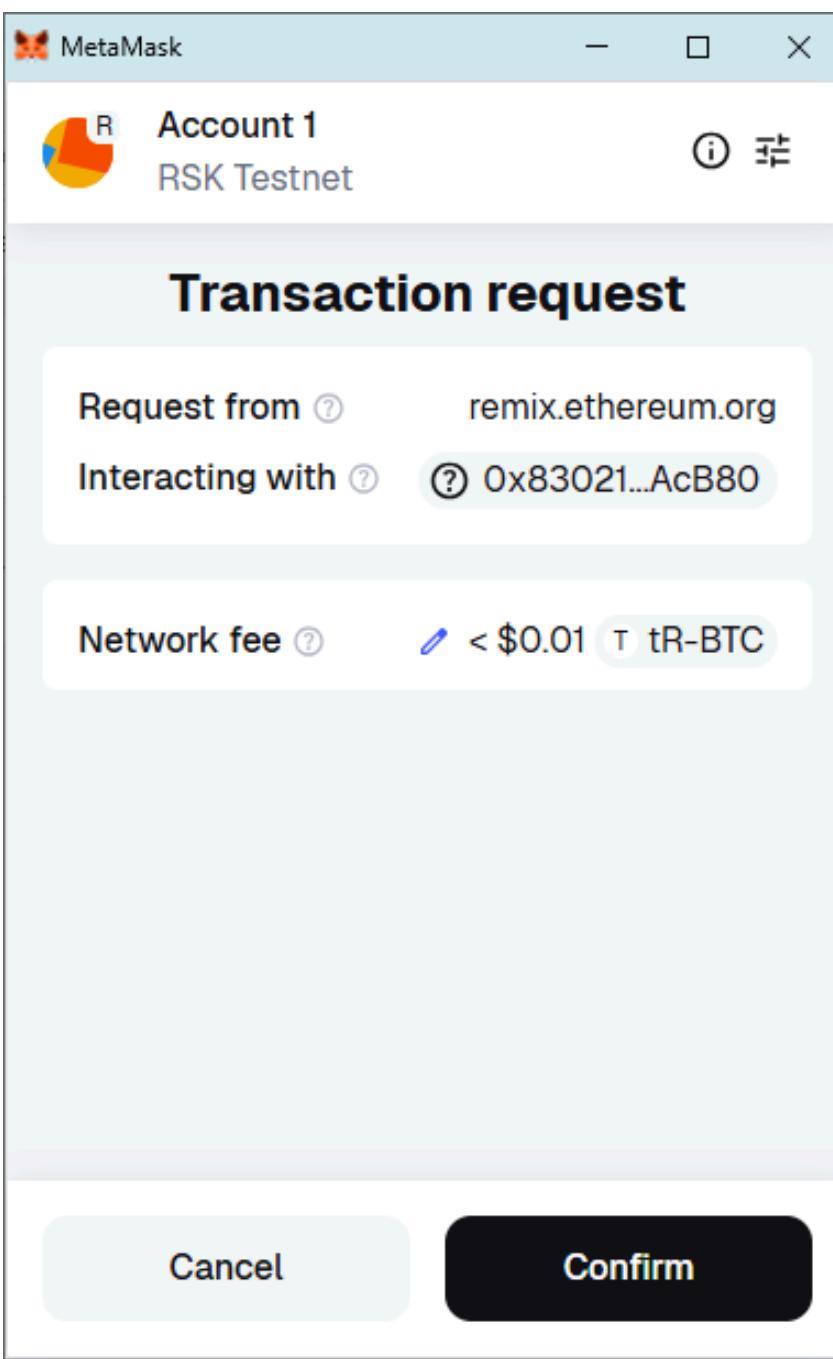
Transaction request

Request from remix.ethereum.org

Interacting with 0x83021...AcB80

Network fee < \$0.01 tR-BTC

Cancel Confirm



MetaMask chrome-extension://nkbihfbeogaeohlefnkodbefgpgknn/home.html#

0xAADfb...d7387

0.0005 TR-BTC ⓘ
+\$0 (+0.00%) Discover ↗

Buy/Sell Swap Send Receive

Tokens DeFi NFTs Activity

RSK Testnet

Sep 27, 2025

Contract interaction Pending

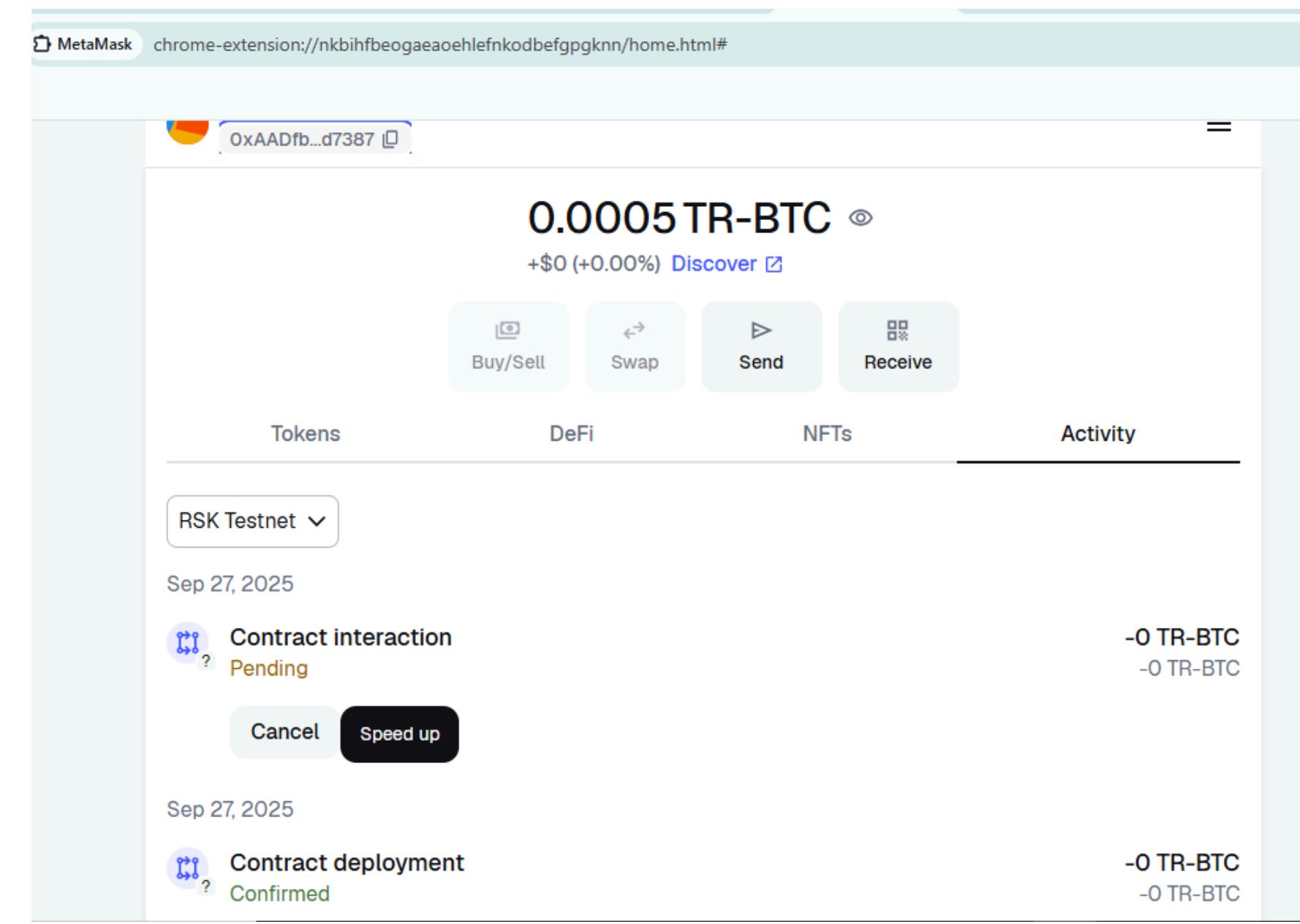
Cancel Speed up

Sep 27, 2025

Contract deployment Confirmed

-0 TR-BTC -0 TR-BTC

-0 TR-BTC -0 TR-BTC



Interact with the smart contract

Contract interaction

Status View on block explorer
Confirmed Copy transaction ID
From To
 → 
Transaction
 Nonce 1
 Amount -0 TR-BTC
 Gas Limit (Units) 150492
 Gas Used (Units) 150492
 Gas price 0.025546895
 Total 0.00000384 TR-BTC
[+ Activity log](#)

GETPRODUCT

call

 0: tuple(uint256,string,string,string,string): 1,Rice Batch 1,Farmer A,2024-09-27,Village X

 0: uint256: 1

PRODUCTS

call

 0: uint256: id 1
 1: string: name Rice Batch 1
 2: string: farmerName Farmer A
 3: string: harvestDate 2024-09-27
 4: string: location Village X

MetaMask - X

R Account 1 RSK Testnet (i) 

Deploy a contract

This site wants you to deploy a contract

Request from  remix.ethereum.org

Network fee  < \$0.01  tR-BTC

FoodTraceability.sol

Contract deployment

Status: **Confirmed** [View on block explorer](#) [Copy transaction ID](#)

From: 0xAADfb...d7387 **To:** New contract

Transaction

Nonce	5
Amount	-0 TR-BTC
Gas Limit (Units)	722375
Gas Used (Units)	722375
Gas price	0.0260656
Total	0.00001883 TR-BTC

+ [Activity log](#)

Contract interaction

Status: **Confirmed** [View on block explorer](#) [Copy transaction ID](#)

From: 0xAADfb...d7387 **To:** 0x1B28e...85794

Transaction

Nonce	7
Amount	-0 TR-BTC
Gas Limit (Units)	128524
Gas Used (Units)	128524
Gas price	0.025539231
Total	0.00000328 TR-BTC

+ [Activity log](#)

FOODTRACEABILITY AT 0X1B2

Balance: 0 ETH [CallData](#) [Parameters](#) [call](#)

UPDATETRACE

_productId:	1
_distributor:	Mahesh
_transportDate:	2024-10-26
_retailer:	Suresh
_qualityCheck:	Good

[Calldata](#) [Parameters](#) [transact](#)

GETTRACE

_productId:	1
-------------	---

[Calldata](#) [Parameters](#) [call](#)

o: tuple(uint256,string,string,string): 1,Mahesh,2024-10-26,Suresh,Good

[Calldata](#) [Parameters](#) [call](#)

o: tuple(uint256,string,string,string): 1,Mahesh,2024-10-26,Suresh,Good

TRACES

: 1

[Calldata](#) [Parameters](#) [call](#)

o: uint256: productId 1

1: string: distributor Mahesh

2: string: transportDate 2024-10-26

3: string: retailer Suresh

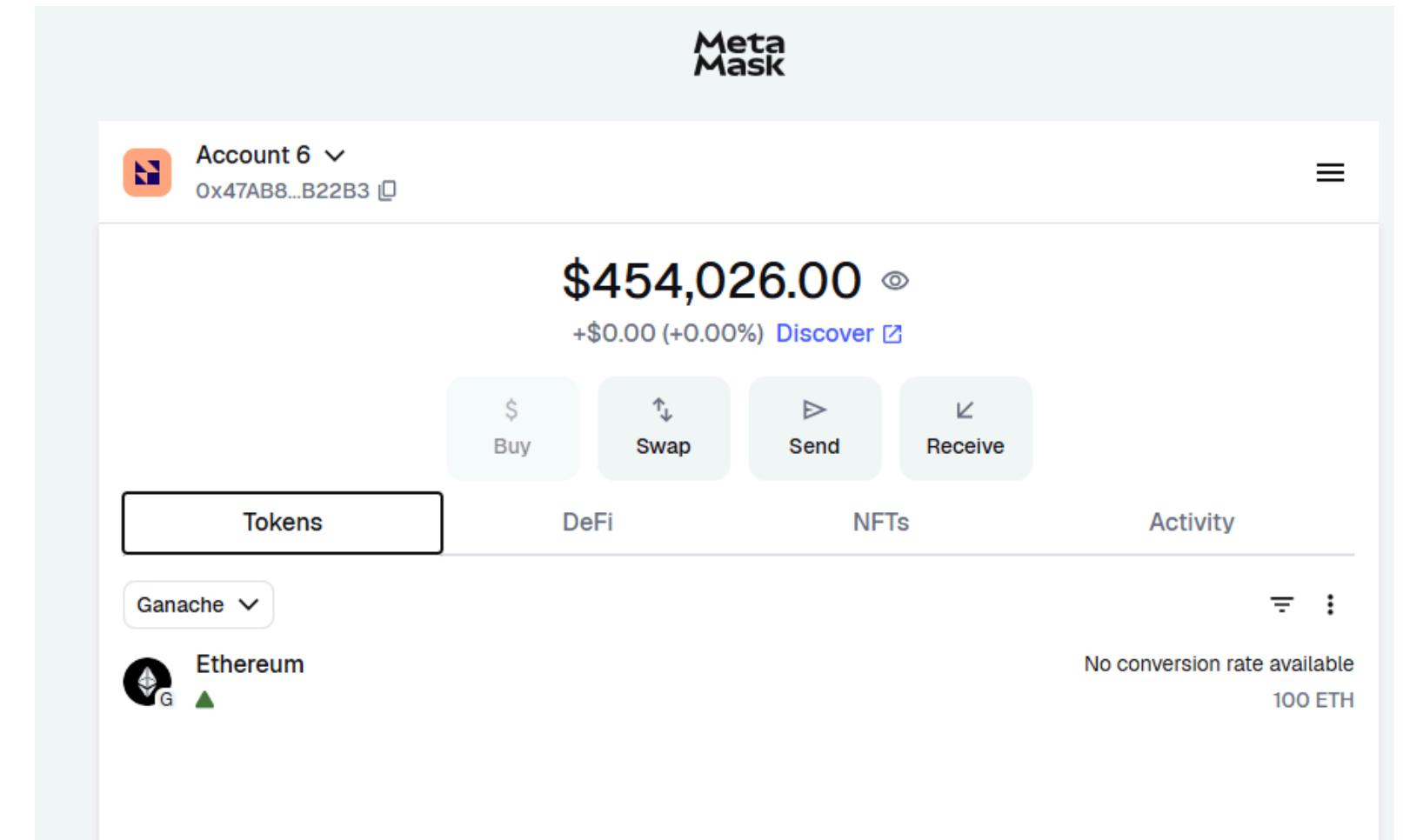
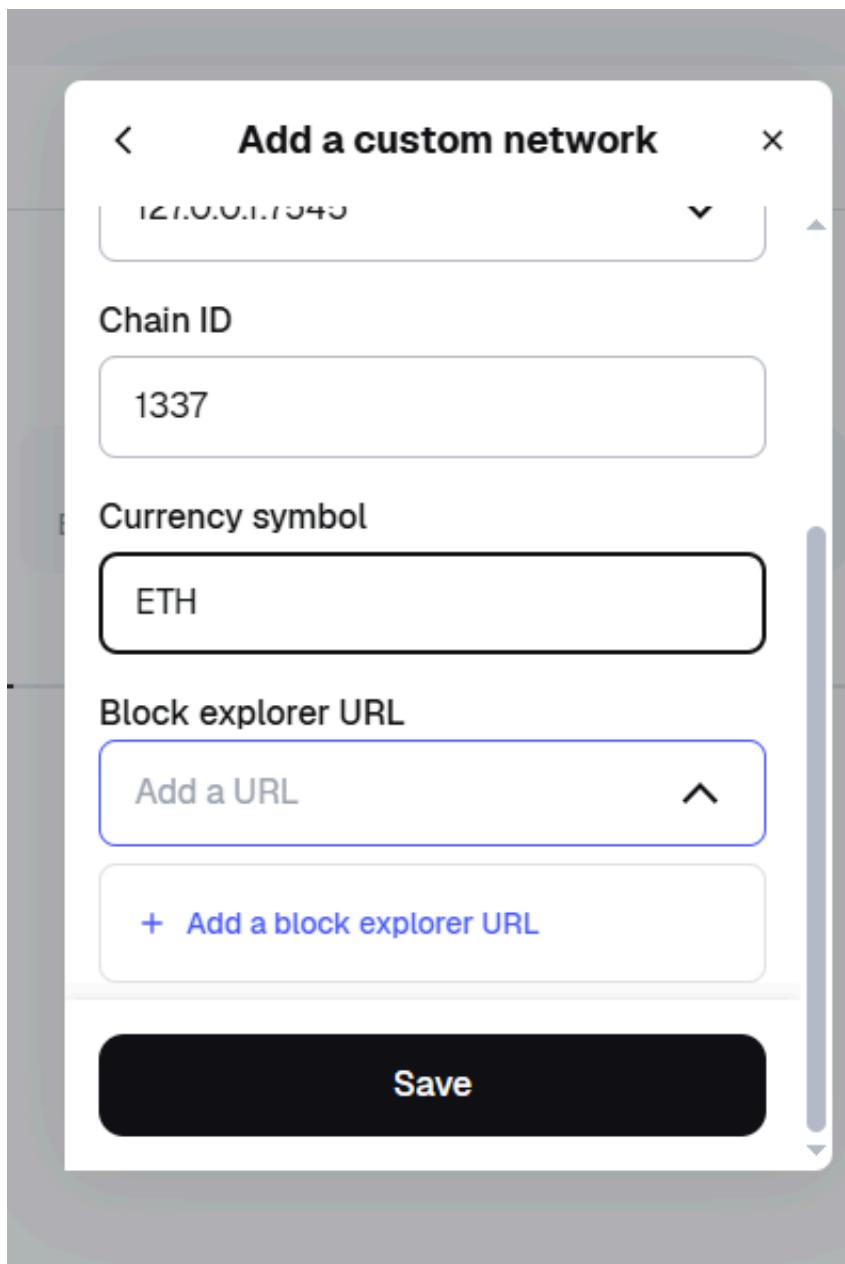
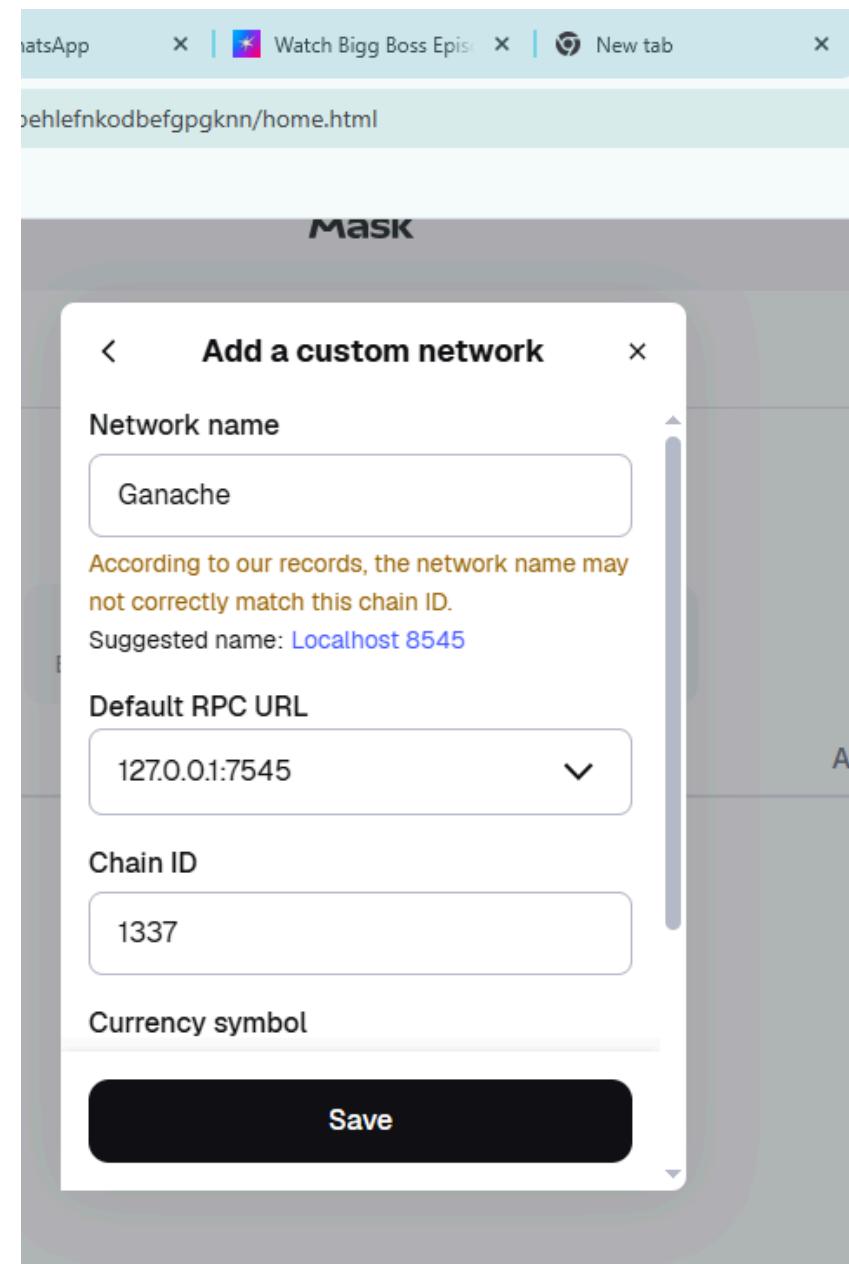
4: string: qualityCheck Good

Low level interactions [i](#)

CALldata [Transact](#)

Interact With Contract

IMPLEMENTATION OF EXP 8



The screenshot shows the REMIX IDE interface. The code editor displays the following Solidity code for the "FoodRegistration1" contract:

```
// SPDX-License-Identifier: MIT
pragma solidity ^0.8.0;

contract FoodRegistration1 {
    struct Product {
        uint id;
        string name;
        string farmerName;
        string harvestDate;
        string location;
    }

    mapping(uint => Product) public products;
    uint public productCount;

    function registerProduct(string memory _name, string memory _farmerName, string memory _harvestDate, string memory _location) public {
        productCount++;
        products[productCount] = Product(productCount, _name, _farmerName, _harvestDate, _location);
    }
}
```

The image shows a modal window titled "Contract deployment" with the following details:

Status: Confirmed [View on block explorer](#) [Copy transaction ID](#)

From: 0x47AB8...B22B3 **To**: New contract

Transaction

		Activity
Nonce	0	
Amount	-0 ETH	
Gas Limit (Units)	1052970	
Gas Used (Units)	1052970	
Base fee (GWEI)	0.875	
Priority fee (GWEI)	19.125	
Total gas fee	0.0210594 ETH \$95.49	-0
Max fee per gas	0.00000002 ETH \$0.00	-\$
Total	0.0210594 ETH \$95.49	

The screenshot shows the MetaMask wallet interface. At the top, it displays "Account 6" with the address "0x47AB8...B22B3". The main balance is shown as "\$453,314.51" with a small "eye" icon. Below the balance, there's a link to "Discover" with a magnifying glass icon. There are four buttons: "Buy" (with a dollar sign), "Swap" (with a double arrow), "Send" (with a right-pointing arrow), and "Receive" (with a left-pointing arrow). Below these buttons are tabs for "Tokens", "DeFi", "NFTs", and "Activity", with "Activity" being the active tab. A dropdown menu shows "Ganache" and the date "Oct 5, 2025".

MetaMask

Account 6

0x47AB8...B22B3

\$453,314.51

+\$0.00 (+0.00%) Discover

Buy Swap Send Receive

Tokens DeFi NFTs Activity

Ganache

Oct 5, 2025

The screenshot shows the Ganache UI. At the top, it has tabs for "ACCOUNTS", "BLOCKS", "TRANSACTIONS", "CONTRACTS", "EVENTS", and "LOGS". A search bar at the top right allows searching for block numbers or transaction hashes. Below the tabs, it shows network status: "CURRENT BLOCK 1", "GAS PRICE 20000000000", "GAS LIMIT 6721975", "HARDFORK MERGE", "NETWORK ID 5777", "RPC SERVER HTTP://127.0.0.1:7545", and "MINING STATUS AUTOMINING". It also includes "WORKSPACE QUICKSTART", "SAVE", "SWITCH", and a gear icon.

Ganache

ACCOUNTS BLOCKS TRANSACTIONS CONTRACTS EVENTS LOGS

SEARCH FOR BLOCK NUMBERS OR TX HASHES

CURRENT BLOCK 1

GAS PRICE 20000000000

GAS LIMIT 6721975

HARDFORK MERGE

NETWORK ID 5777

RPC SERVER HTTP://127.0.0.1:7545

MINING STATUS AUTOMINING

WORKSPACE QUICKSTART

SAVE SWITCH

Ganache							Mainnet			
ACCOUNTS	BLOCKS	TRANSACTIONS	CONTRACTS	EVENTS	LOGS	SEARCH FOR BLOCK NUMBERS OR TX HASHES				
CURRENT BLOCK 1	GAS PRICE 20000000000	GAS LIMIT 6721975	HARDFORK MERGE	NETWORK ID 5777	RPC SERVER HTTP://127.0.0.1:7545	MINING STATUS AUTOMINING	WORKSPACE QUICKSTART	SAVE	SWITCH	⚙️
MNEMONIC twenty jacket best feature sand float title toast enjoy allow clock forget							HD PATH m/44'/60'/0'@account_index			
ADDRESS 0x47AB8644F5c8108daF499679Ca9Cb01217fB22B3	BALANCE 99.98 ETH					TX COUNT 1	INDEX 0			
ADDRESS 0x0aDf7AFCbCa62B236E45B3A0FA8EC31e660Ce083	BALANCE 100.00 ETH					TX COUNT 0	INDEX 1			
ADDRESS 0xc33E05e82A7eFFC22a9981d7F6b3b0E949caA96	BALANCE 100.00 ETH					TX COUNT 0	INDEX 2			
ADDRESS 0xFA86106f0604e85Bd15C6B4Bc5C7f2b70777324f	BALANCE 100.00 ETH					TX COUNT 0	INDEX 3			
ADDRESS 0xE95c6F82062128Fa8580fDb3d7f13873e5Add1e1	BALANCE 100.00 ETH					TX COUNT 0	INDEX 4			
ADDRESS 0xA6A862fb598427870bcA45bd107Feb5799CC09F	BALANCE 100.00 ETH					TX COUNT 0	INDEX 5			

Contract interaction

Status: Confirmed

From: 0x47AB8...B22B3 To: 0xa5aDc...98C9c

Transaction

Nonce	1
Amount	-0 ETH
Gas Limit (Units)	160345
Gas Used (Units)	160345
Base fee (GWEI)	0.799891302
Priority fee (GWEI)	19.200108698
Total gas fee	0.003207 ETH \$14.53
Max fee per gas	0.00000002 ETH \$0.00
Total	0.0032069 ETH \$14.53

MetaMask Account 6 Ganache

Transaction request

Request from remix.ethereum.org Interacting with 0xa5aDc...98C9c

Network fee: 0.0032 ETH \$14.53

Speed: Max fee: 0.0032

Nonce: 1

Data:

Cancel **Confirm**

umbai

GETPRODUCT

id: 1

Calldata Parameters call

0: tuple(uint256,string,string,string): 1,Rice,ABC,24-09-2023,Mumbai

productCount

0: uint256: 1

PRODUCTS

1

Calldata Parameters call

0: uint256: id 1
1: string: name Rice
2: string: farmerName ABC
3: string: harvestDate 24-09-2023
4: string: location Mumbai

Low level interactions i

CALldata

DEPLOY & RUN TRANSACTIONS

Transactions recorded 2 i

Deployed Contracts 1

FOODREGISTRATION1 AT 0x91

Balance: 0 ETH

REGISTERPRODUCT

_name: Rice
_farmerName: ABC
_harvestDate: 24-09-2023
_location: Mumbai

Calldata Parameters transact

getAllProducts

0: tuple(uint256,string,string,string,string)[]: 1,Rice,ABC,24-09-2023,Mumbai

CONCLUSION



- Successfully implemented FoodRegistration and FoodTraceability smart contracts on a private blockchain.
- Farmers can securely register crop details; distributors and retailers can update product journey.
- Blockchain ensures transparency, immutability, and trust in the agricultural supply chain.
- Enables full farm-to-consumer traceability, improving food safety and authenticity.
- Demonstrates the potential of blockchain to enhance efficiency and accountability in agriculture.

THANK
YOU