Case studies for Agrometeorological Services: Indian Experience

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The Agromet services provide a very special kind of inputs to the farmer as advisories that can make a tremendous difference to the agriculture production by taking in time actions against extreme weather events.

This has a potential to change the face of India in terms of food security and poverty alleviation.

**Operational Agrometeorology**

Network of AAS units in the country

Network of 130 Agromet Field Units
Conventional Observational Network

- Surface Observatories – Class I and Class II - (559)
- Pilot Balloon- (71)
- Agrometeorological Observatories- (219)
- Hygrometeorological Observatories - (701)
- Non-Departmental Raingauge Stations
  - Reporting- (3540)
  - Non-reporting- (5039)
- Extreme Weather reporting – Storm surge,
- Frost, Heat wave, Hall storm etc.

Doppler Weather Radar
16 DWRs are installed
Products are
- Rain intensity
- Cumulative rain
- Cloud motion winds
- Vertical profiles of Temperature, humidity etc.

(Res: 0.5x0.5 km)
Assimilation of DWR data with AWS observations (Res: 9x9km)

675 Automatic Weather Stations

127 Agro-AWS
548 AWS

Type of Observatory | Installed | Proposed
---|---|---
AWS | 675 | 400
ARG | 1350 | 2000
DWR | 16 | 42

India's advanced weather satellite INSAT-3D launched in the early hours of July 26, 2013 from Kourou, French Guiana, and has successfully been placed in Geosynchronous orbit.

It carries four payloads
- Imager (Six Channels)
- Sounder (Nineteen Channels)
- Data Relay Transponder(DRT)
- Satellite Aided Search and Rescue (SAS & R)
DISTRICT LEVEL FORECAST

INDIA METEOROLOGICAL DEPARTMENT
NWF MODELS BASED DISTRICT LEVEL WEATHER PREDICTION
ISSUED ON: 02-04-2014
VALID TILL 08:30 IST OF THE NEXT 5 DAYS

DISTRICT : FUNE
STATE : MAHARASHTRA

<table>
<thead>
<tr>
<th>PARAMETERS</th>
<th>DAY-1 03/04</th>
<th>DAY-2 04/04</th>
<th>DAY-3 05/04</th>
<th>DAY-4 06/04</th>
<th>DAY-5 07/04</th>
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<tbody>
<tr>
<td>Rainfall (mm)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Max Temperature (deg C)</td>
<td>34</td>
<td>35</td>
<td>37</td>
<td>36</td>
<td>37</td>
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<tr>
<td>Min Temperature (deg C)</td>
<td>21</td>
<td>22</td>
<td>24</td>
<td>23</td>
<td>23</td>
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<tr>
<td>Total cloud cover (octa)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Max Relative Humidity (%)</td>
<td>35</td>
<td>32</td>
<td>34</td>
<td>43</td>
<td>35</td>
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<tr>
<td>Min Relative Humidity (%)</td>
<td>17</td>
<td>16</td>
<td>15</td>
<td>13</td>
<td>13</td>
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<tr>
<td>Wind speed (kmph)</td>
<td>008</td>
<td>009</td>
<td>008</td>
<td>008</td>
<td>008</td>
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<tr>
<td>Wind direction (deg)</td>
<td>178</td>
<td>23</td>
<td>326</td>
<td>287</td>
<td>291</td>
</tr>
</tbody>
</table>

NOTE: -99.0 ....... NO DATA
Aridity Anomaly Maps

Aridity Anomaly Map gives information about the moisture stress experienced by growing plant. This analysis would indicate qualitatively retardation in the plants growth and so poor yields. Indirectly, this may also be helpful for irrigation scheduling, the amount and the time at which the water is badly needed by the plant.

Standard Precipitation Index (SPI) Maps
IMD in collaboration with ISRO started generating and using the Normalised Difference Vegetation Index (NDVI), derived from INSAT 3A CCD data, during Monsoon 2013 for agromet advisories.

Monitoring of Pests & Diseases from Satellite Data

INSAT-3D : Science Products
- Total Ozone
- Temp/Humidity Profiles
- Upper Tropospheric Humidity
- Aerosols
- Atmospheric Motion Winds
- Clouds
- Quantitative Rain
- LST, NDVI, ET, SST
- Snow, Fire, Smoke, Fog,

Cold injury alarm
- Crop protection
  Advisory - Arrange for smoking around the field and apply light irrigation to the crop. Spray fresh water to the bunches.

INDIA METEOROLOGICAL DEPARTMENT
Tactical Decisions

In Farm operations

Seed Management, Irrigation, Fertilizer Application, Pesticide spraying, etc...

Weather forecast Applications

Sowing Transplanting Vegetative Grain formation Harvesting, etc...

In different stages of crops
### Statewise 600 district bulletins of the country

<table>
<thead>
<tr>
<th>S. No.</th>
<th>State</th>
<th>No. of districts</th>
<th>S. No.</th>
<th>State</th>
<th>No. of districts</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Andhra Pradesh</td>
<td>22</td>
<td>15</td>
<td>Manipur</td>
<td>9</td>
</tr>
<tr>
<td>2</td>
<td>Assam</td>
<td>26</td>
<td>16</td>
<td>Meghalaya</td>
<td>7</td>
</tr>
<tr>
<td>3</td>
<td>Arunachal Pradesh</td>
<td>14</td>
<td>17</td>
<td>Mizoram</td>
<td>8</td>
</tr>
<tr>
<td>4</td>
<td>Bihar</td>
<td>38</td>
<td>18</td>
<td>Nagaland</td>
<td>11</td>
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<td>5</td>
<td>Chhattisgarh</td>
<td>20</td>
<td>19</td>
<td>Orissa</td>
<td>29</td>
</tr>
<tr>
<td>6</td>
<td>Gujarat</td>
<td>26</td>
<td>20</td>
<td>Punjab</td>
<td>16</td>
</tr>
<tr>
<td>7</td>
<td>Haryana</td>
<td>21</td>
<td>21</td>
<td>Rajasthan</td>
<td>33</td>
</tr>
<tr>
<td>8</td>
<td>Himachal Pradesh</td>
<td>12</td>
<td>22</td>
<td>Tamil Nadu</td>
<td>34</td>
</tr>
<tr>
<td>9</td>
<td>Jammu &amp; Kashmir</td>
<td>17</td>
<td>23</td>
<td>Tripura</td>
<td>8</td>
</tr>
<tr>
<td>10</td>
<td>Jharkhand</td>
<td>24</td>
<td>24</td>
<td>Uttar Pradesh</td>
<td>71</td>
</tr>
<tr>
<td>11</td>
<td>Karnataka</td>
<td>30</td>
<td>25</td>
<td>Uttarakhand</td>
<td>6</td>
</tr>
<tr>
<td>12</td>
<td>Kerala</td>
<td>14</td>
<td>26</td>
<td>West Bengal</td>
<td>18</td>
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<tr>
<td>13</td>
<td>Madhya Pradesh</td>
<td>50</td>
<td>27</td>
<td>New Delhi</td>
<td>1</td>
</tr>
<tr>
<td>14</td>
<td>Maharashtra</td>
<td>32</td>
<td>28</td>
<td>Andaman &amp; Nicobar</td>
<td>1</td>
</tr>
</tbody>
</table>

Total no. of bulletins issued: 600

### Sample SMS in English and regional language

- **Forecast of no rainfall for next 5 days in Kurnool Dist.** Max temp 42-43 degree centigrade and Slight Increase in Day and night temperatures. min temp 24-26 degree centigrade Wind speed 9-10 Kmph. Decrease in Relative Humidity.

- **আগামী ৫ দিন বৃষ্টি হবেনা** ,প্রোজেক্টে সেচ করুন ,বাদাম চাষে কাভ পচা রান্না রান্না করুন এবং ধান চাষ করুন।

- **নালায় জল স্পেস করুন। ভাতে ধান চাষ ধসা রান্নার জন্য থাকুন।**

- **পুনর্নালায় জল স্পেস করুন।**

- **হাফারনার হেল কাফ হেল কাফ।**

- **25ml/lt jole স্পেস করুন।**

- **থাকুন।**

- **ানিয়ের জন্য থাকুন।**

- **িনার আল বা hexaconazol (কাফ) ৫% ১৫ মিলি।**

- **ল জল স্পেস করুন।**

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Indian Meteorological Department
Dissemination of Agromet Advisories to the users

Operational communication linkage between Agromet Advisory Service Unit and end-users (farmers) for effective communication.

Forecast from IMD, New Delhi

State Met Centres

Agromet Advisory Bulletin by AMFUs

Postal Contact

SMS on mobile

Personal Contact

Farmers

State Agril. Dept.

Krishi Vigyan Kendra

News Papers

Website

Television

Radio

Call flow for Agromet advisories on mobile

Agro Advisory Icon

Farmers feedback Through mobile
Coverage of SMS service through PPP mode in the country

In all 5.06 million farmers across 20 states are taking benefit of the SMS service of IMD.
TCS workflow
Accurate Plant Disease forecast and minimize the spray of pesticides

Farmer with mobile-phone

Mobile service provider

Internet Cloud

Farms

mKRISHI Weather Station

Wireless Sensor Networks

mKRISHI Station

Parameter Update

Query

Response

Alert
Your farm is highly susceptible to Late Blight.
To determine whether to spray or not, closely observe your leaves, stem and tuber on your field and answer following questions.

<table>
<thead>
<tr>
<th>Question 1</th>
<th>Question 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Have you observed any water soaked, light brown lesion on the leaf blade.</td>
<td>Have you observed lesions spreading faster over the entire leaflet and petiole.</td>
</tr>
<tr>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Ans Now</td>
<td>Ans Latter</td>
</tr>
</tbody>
</table>

Expert’s Advice
After closely examining, our advice is to...

Question 3

| Yes | No |
| Ask Query | Exit |

Mobile phone Application for Parameters/Queries/Symptoms update
Touch Screen Information Kiosk (TSIK) initiative for farmers by Central Research Institute of Dry Land Agriculture (CRIDA) Hyderabad, India

Touch screen kiosks provide one stop access to information needs of individual or group of farmers with minimum literacy standards. Kiosk allows users to navigate for information on:

- Agromet Advisory
- Crops cultivation practices,
- Agriculture inputs
- Crop diagnostic kit
- Management time table
- Farm machinery and
- Market information etc.,
Popularisation and feedback mechanism of agromet advisories

Feedback form in regional language

- Brochures/Pamphlets
- Field visits/Field days/Field demonstrations
- Visit of experts in the field
- Feedback mechanism through personal contact, kisan melas, awareness programmes

State Level Review Meetings

Awareness Programmes

Farmers Field Schools
Farmers’ feedback

Shri Narayan Bhai Chawda (Krishi Pandit),
Village–Gomchi, Raipur

Since 1992, I have been getting these weather-based agro-advisories regularly on the evening of every Tuesday and Friday. Although, we have been involved in agriculture since last 30 to 35 years, these agro-advisories are certainly playing very important role in planning our agriculture activities. Vegetables and the cereals are the major crops grown in my agriculture farm.

Shri Jayant Bhai Taunk, Village-Doma, Raipur

Weather forecasts and agro-advisories issued by the university are definitely playing an important role and I am very much dependent on AAS bulletins for scheduling different agricultural operations like fertilizer application, spraying of weedicides and pesticides, drip irrigation etc. I am very much interested in satellite pictures. It would be better if these pictures appear in local Newspapers every day.

Economic Impact of Gramin Krishi Mausam Seva

Extrapolation can rise to Rs.211,000 crores if the entire farming community were to apply Agromet information to their agricultural activity.

Potential economic benefit estimated by NCAER, Rs.50,000 crores per year (used by 24% farmers).

In line with recommendations of PMO wrt. the demands raised by Bharat Krishak Samaj and MPs for expansion of the service to village level

Economic Assessment by NCAP on IAAS estimated 10-25% economic benefit obtained by the farmers.
Economic benefit of farmer

Gurjeet Singh, Naruana, Bathinda, Punjab

Farmer has inquired about weather because he wants to sow cotton in 7 acres.

There was possibility of rain in coming days so he was advised not to sow cotton seed in the field as it will affect germination due to crust formation.

Farmer saved seed which cost around 7,000 for 7 acre.

Himsanker, Katal, Nalagarh, Solan, Himachal Pradesh

The farmer belongs to mid hill area of Himachal, where climate is quite suitable for the production of cash crops mainly tomato and capsicum, but erratic weather conditions interrupt while following regular spray schedule.

He was benefitted a lot with voice message service mainly based on agro-advisory. According to his estimate, last year he could save approximately 20 percent of total input cost invested on various spray schedules of chemicals like insecticides, fungicides, micro-nutrients, growth regulators etc.

He can save 20% of total input i.e. 8,000/-

Datta Giri, Hadli, Latur, Maharashtra

I listen to your weather alert voice message for soybean grown area. So please suggest me how to protect harvested soybean from thunder shower.

There are good chances of thunder shower in your soybean grown area. In such climatic conditions, protect the harvested grains from rain and excessive dew by covering. Keep the harvested soybean in a dry and shady place.

Increase in net income = Rs. 35500.
Capacity Building

- Agromet Core Course
- Basic Agromet Course
- Meteorologists Grade II
- Foreign Training
- Summer Placement Course
- Refresher Course
- Agromet Observers’ Course
- Training course on ‘Agrometeorology towards better advisories for serving end users requirement’
- Training to NABARD District Correspondents
- Training to Kisan Call Centres
The objective of these programmes is to make farmers become more self-reliant in dealing with weather and climate issues that affect agricultural production on their farms and to increase the interaction between the farmers and the AgroMeteorological Service providing agencies i.e. IMD, SAUs, ICAR etc.

Such programs help increase the interaction between the local farming communities and the Meteorological Centres (MCs), AgroMeteorological Field Units (AMFUs) and Krishi Vigyan Kendra (KVK).

Our moto is one rain gauge for one village.
M S Swaminathan Research Foundation, Tamil Nadu India, initiated the "Programme for the Empowerment of Women Farmers", the "Mahila Kisan Sashaktikaran Pariyojana (MKSP)" for empowering women farmers. The programme aims at creating an environment of hope that will help alleviate the mood of distress and empower women farmers.

Consultative Group on International Agricultural Research (CGIAR) has done research on gender and agriculture. They are currently exploring ways to improve women’s role in climate change mitigation activities and decisions.

IMD has conducted a 4 days training to the Telefarm Advisors on Weather Related queries.
**IMD** has started providing local specific short range weather predictions for **Sangamner** and **Akole** clusters (WOTR’s operational area) of Ahmednagar district from April 2012.

- The weather predictions are used by WOTR to prepare agro advisories. WOTR’s agriculture team prepares agro advisory according to the conditions of the major crops standing in the field. The advisory is in the form of wall paper. WOTR’s field agronomists share it with the farming community at 5-6 locations in every village.
IMD in Collaboration with Indian Institute of Tropical Meteorology, Pune and Institute of Information technology, Khargpur started on a pilot mode experimental Agromet Advisory bulletin. The Climate bulletin has mainly three components:

i. Realized rainfall for the preceding two months
ii. Rainfall forecast: Long range Forecast of IMD, 4 pentads (5 days each) from IITM, Pune and deterministic and probabilistic forecast from IIT, Khargpur
iii. Broad Agromet Advisories based on the realized and forecasted rainfall along with crop status for six homogeneous regions viz. South India, West India, Central India, East India, North India and Northeast India
Use of LRF in Agriculture

For seasonal planning on
- Type of crop/variety to be sown
- Proportion of area under different crops
- How much of land, if any, to keep fallow
- Redistribution of inputs (seed, fertilizer, pesticides etc.)
- Arranging for Power & Water Resources
- Preparation of Contingency Plans
- Preliminary enquiries on exports/imports

Help make the best use of a good season and minimize the harmful impacts of the adverse one.

Special weather forecast for extreme events

- Tropical Storms → Drought, Floods → Heat Wave, Cold Wave
- Dust storms, hailstorms → Heavy rainfall → Tornadoes
- Sand storms → Pest & disease outbreak → Frost, snow and ice storms
National Level Bulletin

State Level Bulletin

District Level Bulletin for Chennai

Friday 21st March 2014
(For the period 21st to 25th March 2014)

Issued by
National Agrometeorological Advisory Service Centre,
Agricultural Meteorology Division,
India Meteorological Department,
Shivajinagar, Pune.
In India, Gram means village-
Lowest identified areas upto which agromet advisories should reach

- To improve the existing District level Agromet Advisory Services (AAS) to the sub district level and in pilot mode at block level.

- To establish District AgroMet Units (DAMU) in 240 selected districts, in addition to already operating 130 AMFUs /DAMUs, in order to meet the said expansion.

- To expand the existing channels of communication of weather based agromet advisory to the farmers through on line mode.

- To establish Agromet Data Centre, as part of the National Data Centre of IMD, for archiving and reaping maximum benefits out of agro meteorological information.
## Climate during the recent past

### Extreme Events

- 2002 drought
- 20 day heat wave during May 2003 in Andhra Pradesh
- Extreme cold winter in the year 2002-03
- Drought like situation in India in July 2004
- Abnormal temperatures during March 2004 and Jan 2005
- Floods in 2005
- Cold wave 2005 - 06
- Floods in arid Rajasthan & AP and drought in NE regions in 2006
- Abnormal temperatures during 3rd week of Jan to 1st week of Feb 2007
- All India Severe drought 2009
- 2010 – One of warmest years
- 2011 – Failure of September rains in AP
- 2012 – early season drought

### All India SWM Rainfall Departure (%)

<table>
<thead>
<tr>
<th>Year</th>
<th>All India SWM Rainfall Departure (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>-8</td>
</tr>
<tr>
<td>2001</td>
<td>-15</td>
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<tr>
<td>2002</td>
<td>-19</td>
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<td>2008</td>
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<td>2009</td>
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<td>2010</td>
<td>+2</td>
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<tr>
<td>2011</td>
<td>+1</td>
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<tr>
<td>2012</td>
<td>-8</td>
</tr>
</tbody>
</table>
Increase in Surface Temperature in India

- Observations
- Predictions with Anthropogenic/Natural forcings
- Predictions with Natural forcings

Increase in temperature (°C)


1.0° C
Challenges facing agriculture

- Raising awareness of vulnerable populations especially in the Americas, Africa, Asia and Small Island States through education and outreach is essential;
- Adaptation to change is now the only viable strategy to avoid social hardship now and in the future;
- It is essential that the CAgM programme addresses these challenges.
CREAM will work to channelize R&D products and tools for their applications in AGROMET sectors in areas:

- Integration of R&D work on climate forecast development.
- Help channelize farm inputs from different line function departments.
- Help farmers cope with climate risks and uncertainties.
- Help reduce the vulnerability of agro ecosystems to climate variability and change.
- Help achieve greater efficiency in natural resource use in agriculture.
- Establish a World Class Training Programme in Agricultural Meteorology.

**Key Gaps in Agriculture Climate Services**

- Range of climate risk management services for smallholders – tools, technologies
- Integrated water resource management
- Integrated networks & services
- Early warning and disaster risk management
- Climate modeling, weather information and environmental monitoring

It is proposed to establish Cell for Research and Excellence in Agricultural Meteorology (CREAM) to address these issues.

Creation of Cell for Research and Excellence in Agrometeorology (CREAM) in IMD New Delhi for converging the R&D needs for operational Agromet services.
Thank you
Case studies on Agrometeorological Bulletins in other countries

- Qatar and Bahrain, agrometeorological activities are conducted within the Ministry of Agriculture.

- In Japan and Vietnam, agrometeorological activities are managed jointly by the Ministry of Agriculture and a meteorological organization.

- In Iran, the agrometeorological department is in the Iranian National Meteorological Service, with government having sole responsibility.

- Few countries including Russia, Japan, Mongolia, and China operate agrometeorological activities in both the private and governmental sectors.

- Regarding agrometeorological bulletins, most countries, including China, Korea, Mongolia, Bahrain, and Pakistan, produce agrometeorological data and information such as 10-day or monthly and growth-season bulletins.
Case studies on Agrometeorological weather forecasts in other countries

Long-term predictions, provided based on statistical methods are issued by Bangladesh, Nepal, and Laos. These kinds of predictions lack agrometeorological forecasts and they - 28 - suffice only for weather predictions with a lead-time of 48 hours.

In addition to weather predictions, some countries have agrometeorological forecasts that may include some piece of advice for operational agrometeorological services.
Case studies on dissemination of Agrometeorological information in other countries

In some countries, information is disseminated online and via establishing direct communication links; while in others, data are provided in print and mailed to the users.

In Bangladesh, Nepal, and Laos, data are printed and sent to the users.

Mongolia, China, India, Thailand, Iran, and Uzbekistan have a mass media system to disseminate necessary data during the growth period.

In Qatar, Japan, Vietnam, Uzbekistan, Kazakhstan, Iran, Thailand, China, and Mongolia, the agrometeorological data and bulletins are provided in the form of hard copy and electronic data files.
Bangladesh Agrometeorological Services

Government of the Peoples' Republic of Bangladesh
Bangladesh Meteorological Department
(Agro-meteorology Division)
Meteorological Complex, Agargaon, Dhaka-1207

Forecast for the period: 01.04.2014 to 07.04.2014

Spatial distribution of Rainfall (21-03-2014 to 21-03-2014)
Accumulative Rainfall forecast (01-04, 2014 to 07-04, 2014)
Extended Outlook for accumulative rain (08-04-2014 to 14-04-2014)

Highlights:
Country average of bright sunshine hour was 8.26 hours per day during the last week.
Country average of free water loss during the previous week was averaged 4.71 mm per day.

Weather forecast and Advisory for the period of 01.04.2014 to 07.04.2014.

Bright sunshine hour is expected to be between 7.0 to 8.0 hours per day during this week.
Average of free water loss during the next week is expected to be between 4.0 mm to 5.0 mm per day.

- Trough of low lies over West Bengal and adjoining area. Seasonal low lies over South Bay.
- Light (4-10 mm) to moderate (10-22 mm) rain/thundershower may occur at many places over Sylhet, Dhaka and Chittagong divisions and few places elsewhere over the country with a chance of isolated moderately heavy (22-44 mm) falls accompanied by temporary gusty/squally wind speed 45-60 km per hour or more with hails at places during the middle of this period.
- Day and night temperature may remain nearly unchanged over the country during the first half and slight fall in day and night temperature are expected over the country during the second half of this period.
- Wheat growing farmers are requested to take necessary precaution to save his crop from damage due to rainfall.

(Mahnaz Khan)
Deputy Director
For Director
Phone: 8130305 (Office)
Agrometeorological observation

The CMA operates 653 agrometeorological observing stations and 1210 automatic soil moisture observing stations to observe major crops and meteorological conditions for agricultural production. Additional AWSs have been installed in response to requirements for the local development of the rural economy.