Perspectives from Regional Association V (South-West Pacific)

Rizaldi Boer, Flaviana D. Hilario, Simon McGree,
Bonifacio G. Pajuelas, and Tan Lee Seng
Bogor Agricultural University, Philippine Atmospheric, Geophysical and Astronomical Services Administration, Fiji Meteorological Service, Malaysian Meteorological Service
Bogor, Indonesia; Quezon City, Philippines; Nadi, Fiji Islands; Selangor, Malaysia

Abstract

A questionnaire containing nine questions was circulated in the Regional Association V (RA-V). Responses were received from four countries: Fiji, Indonesia, Malaysia, and Philippines. Based on the responses, it was revealed that Fiji has no independent agrometeorological services unit, while in Indonesia such a unit was developed in 2003. The main customers of the National Meteorological and Hydrological Services (NMHSs) in the four countries are government agencies, in particular the Ministry of Agriculture. In Fiji and the Philippines, the industrial companies are also the customers. The services which are provided in the form of bulletins, assist in conducting strategic studies, provide early warnings, and help with impact assessments.

The main constraints for strengthening the operational agrometeorological services in the four countries are lack of human resources, analytical tools such as simulation modeling, and data. Therefore, recommendations given by the countries for strengthening the operational agrometeorological services include training activities on the use of remote sensing technology and simulation modeling for yield monitoring, forecasting, improvement of climate observation networks, and dissemination systems.

Introduction

There is currently an indication that the impacts of extreme climate events (ECE) on many sectors, particularly in agriculture, are increasing from year to year. For example, in Indonesia before 1994, the loss of national rice production due to ECE was about 0.2 million tons per event and after 1994 it increased to at least 1.0 million tons per event (range between 1.1 and 1.7 million tons per event; Boer and Las, 2002). This condition occurs as a result of increasing population in areas where subsistence agriculture is practiced, and increasing pressure on land and water resources (Jones, 2003). Thus, a small deviation in normal climate could cause a major food shortage and permanent damage to society. In addition, farmers who make routine decisions about production in existing farming systems use very little climate (forecast) information in making their decisions or setting up planting strategies.

The role of NMHSs is to increase the use of climate (forecast) information in many sectors of agriculture. Jones (2003) stated that the effective application of climate forecasts depends on 1) the availability of regional forecasts of adequate lead time and accuracy, 2) the vulnerability of agriculture to weather variability; 3) the existence and awareness of options for using knowledge of future weather to improve agricultural practices, and, 4) the ability and willingness of decision makers to modify their decisions based on climate forecast information. To create conditions that allow for the effective application of climate forecast, the NMHS faces many constraints and limitations.

This paper briefly describes the results of a survey on operational agrometeorological services, and a literature review of operational agrometeorological services in RA-V.

Survey on Operational Agrometeorological Services in RA-V

This section briefly describes the results of a survey conducted in the World Meteorological Organization RA-V (Appendix 1). It might not well represent the condition of the region, since only four countries responded to the questionnaire (Appendix 2), i.e., Fiji, Indonesia, Malaysia, and the Philippines (Appendix 3). The Philippines proposed another set of questions for the survey (Appendix 4).

Agrometeorological Service Unit

In the four countries, only Fiji has no independent agrometeorological service unit. Indonesia just recently established the unit, which also covers air pollution.

Agrometeorological Services

In the four countries, the major customers for the agrometeorological services are the Ministries of Agriculture, research institutes, agricultural industries, and national task forces dealing with climate. The services, which are mostly in the form of issuing regular bulletins or advisories, provide early warnings as appropriate and strategic studies. In the four countries, only the Philippines provide services to help reduce the contributions of agricultural production to global warming. In Indonesia, this type of service is provided by agricultural research agencies.

Constraints and Limitations

Common reasons given by the countries to explain the limited capacity of the NMHS in providing the agrometeorological services are inadequate human resources (low skill), technology, computing facilities, and limited coverage of a national climatological stations' network (in particular for rainfall), and data discontinuity. Indonesia recognizes that lack of skill in forecasting and translating global climate forecasts on a local (downscaling) scale as well as its dissemination to users (farmers in particular) are crucial in strengthening operational agrometeorological services. At present, the NMHSs in the four countries have no regular program to work with agriculture extension. These aspects should get more attention in the future.

Strategy to Strengthen Operational Agrometeorological Services

Most countries feel that the use of agricultural simulation modeling, GIS/remote sensing technologies, and downscaling techniques to localize the regional climate forecasts should be encouraged in order to strengthen operational agrometeorological services. Key factors for the success of operational agrometeorological services are improvement of climate station networks (particularly rainfall networks), timely transfer of local data to an analysis center, forecast delivery from data analysis center to users, ability to localize climate forecast information and assess the impact, and availability of an effective dissemination system. Therefore, a strategy to strengthen the operational agrometeorological services should cover these aspects.

Review of Operational Agrometeorological Services in RA-V

Based on the responses to the questionnaires, the countries felt that skill in using simulation-modeling techniques in strengthening operational agrometeorological services might be important. Development of skills for downscaling global climate forecast to local climate forecast, conducting impact analysis, and designing adaptation strategies to variable climate, such as tailoring crop management to climate forecast, are necessary. Collaboration between NMHSs with other agencies in the country that may have such capacities should be enhanced. International research agencies should also open up free access to global climatic data such as Categorical Climate Forecasts (GCM) outputs and software.

The use of simulation modeling tools in agrometeorological services has been well adopted in Australia (e.g., Rosenthal and Hammer, 1978; Strong, 1981; Woodruff and Tonks, 1983; Hammer and Nicholls, 1996; Hammer, et al., 1999; Meinke & Hochman, 2000; Meike and Stone, 2003). The simulation modeling tools are used to quantify the risks associated with various decision options by integrating knowledge from simulation and other studies using the long-term climate record. The tools are also used to assess the likely distribution of yield or gross margin for a given climate forecast.

Simple models to forecast regional rainfall from global climate-forcing factors have been developed by Australia, such as RAINMAN or Rainfall Information for Better Management (Clewett, et al., 2002). In the RAINMAN, the monthly Southern Oscillation Index (SOI), key indicator of El Niño/Southern Oscillation (ENSO) (Coughlan, 1988) was used to assess the changes in distribution of seasonal rainfall under a given SOI class or phase. The SOI was partitioned into three classes with average SOI>5, average SOI <-5, and average SOI between -5 and 5 (Clewett, et al., 1991) or into five distinct phases, the change in the SOI from month to month, i.e., rapidly raising, rapidly falling, consistent positive, consistent negative and near zero (Stone and Auliciems, 1992, Stone, et al., 1996). It was found that there were consistent differences in probability distributions of rainfall associated with seasons following the SOI classes or phases types. Further effort to include other global climate forcing factors such as IOD (Indian Ocean Dipole) and decadal climate variability indicators such as Interdecadal Pacific Oscillations (IPO) into existing seasonal climate schemes has also been underway (e.g., IOD see Saji, et al., 1999, Yamagata, et al., 2001; IPO see Meinke, et al., 2001).

As global climate-forcing factors to some extent affect the rainfall variability in certain regions, the use of these factors to evaluate the likely yield distributions in the following season under given crop-management strategies has also been adopted in many countries. In this approach, a number of yield data series were generated by running the crop-simulation models using a number of given crop management strategies and long-term daily climatic data. Yield distributions under given global climate-forcing factors were developed. Changes in the distribution will indicate the strength of relationship between yield variability and the factors. For example, a study case at Pusaka Negara, Indonesia, indicated that planting soybeans after April is still possible if the value of SOI phase in April was not 1 or 3 (Figure 1). Chances of getting soybean yield of more than 750 kg/ha for May planting would be more than 50 percent if the April SOI were 2, 4, or 5.

In Fiji, the Philippines, and Indonesia the use of simulation modeling tools in agrometeorological services, to some extent, is still in research stage. The tools are used for setting up crop-management strategies, determining alternative decisions for second planting, and designing optimal land allocation under a given climate forecast (e.g., Indonesia, see

Boer, et al., 2003 and 2004; Philippines, see Messina, et al., 1999; Fiji, see Fiji Meteorological Service, 2003). However, there is a need to make use of such knowledge for influencing policy makers into making decisions and farmers into deciding crop-management strategies. The challenge remaining is to find effective ways to communicate such knowledge and information to policy makers and farmers and to inform local staff about the use of such knowledge.

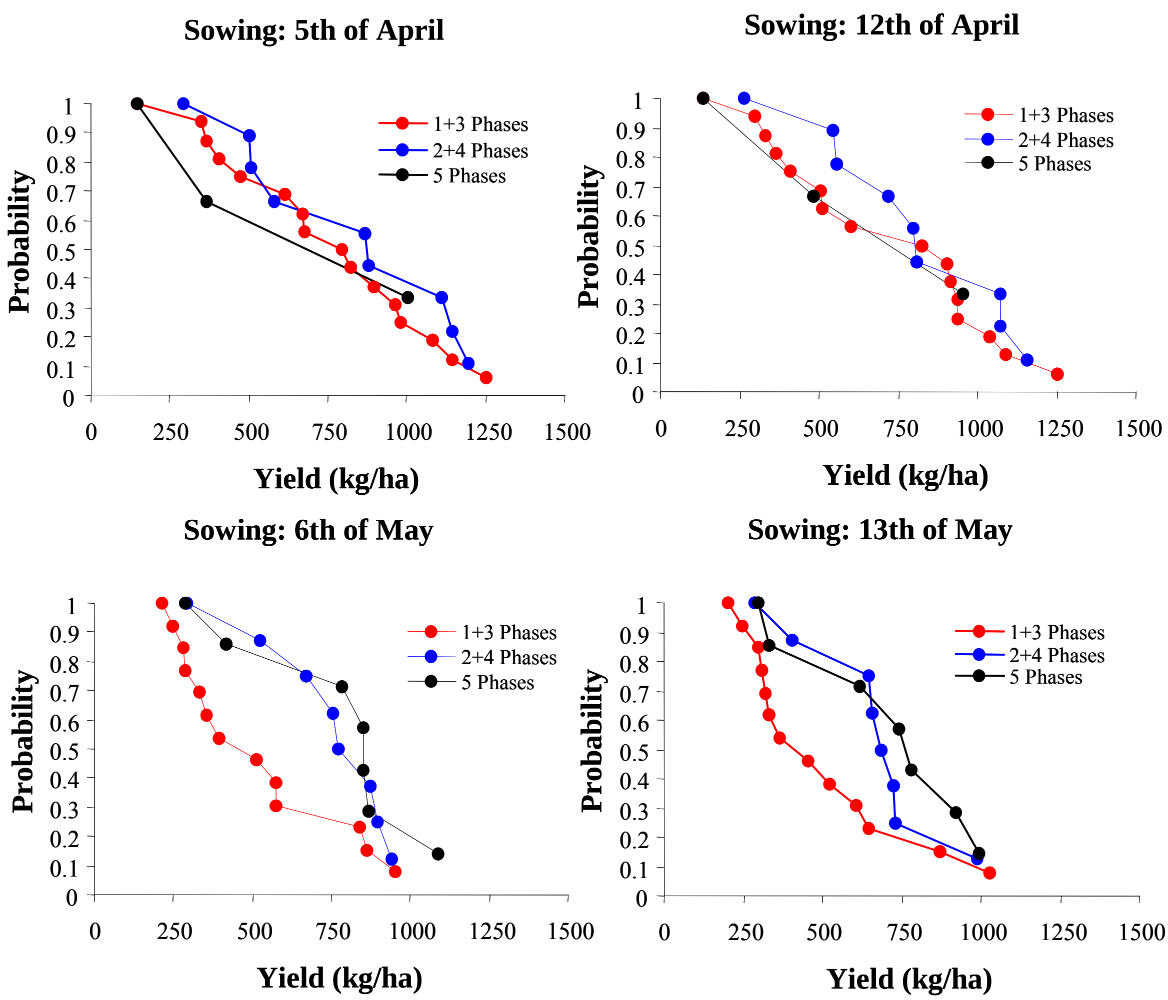

Figure 1. Yield probability at Pusaka Negara using previous month SOI phase (Boer, et al., 2003).

Another technical problem that still remains for using such an approach in developing countries is the availability of long-term records of daily climatic data. In many cases, the long-term data records are available on a monthly basis. Therefore, one possible solution to cope with this problem is to use climatic data generator models that are capable of generating daily, long-term climatic data from the long-term monthly data record. A number of climatic date-generator models with that capacity are available (e.g., Epstein, 1991; Boer, et al., 1999; Boer, et al., 2004).

Conclusions

The main limitations and constraints for strengthening the operational agrometeorological services in Fiji, Philippines, Malaysia, and Indonesia are a lack of human resources and analytical tools such as simulation modeling and data. Training activities on the use of remote sensing technology and simulation modeling for yield monitoring and forecasting and improvement of the climate observation network and dissemination systems are the priorities for improving agrometeorological services in the four countries.

Agricultural simulation modeling is already being used for operational agrometeorological services in developed countries such as Australia. In developing countries, such an approach is still in the research stage. There is a need to influence policy makers into making decisions and farmers into deciding crop-management strategies. The challenge is finding effective ways to communicate such knowledge and information to policy makers and farmers and to help local staff in the use of such an approach.

References

Boer, R., K. A. Notodiputro, and I. Las. 1999. Prediction of daily rainfall characteristics from monthly climate indices. Proceedings of The Second International Conference on Science and Technology for the Assessment of Global Climate Change and Its Impacts on Indonesian Maritime Continent, November 29 to December 1, 1999, T. Sribimawati, et al. (Eds.), Jakarta, Indonesia.

Boer, R. and I. Las. 2002. National Rice Production System in the Perspective of Global Climate Policy. Paper presented at Sukamandi Rice Research Institute, March 4-5, 2002.

Boer, R., Perdinan, and M.K. Rahadian. 2004. The Use of Climatic Data Generator to Cope with Daily Climatic Data Scarcity in Simulation Studies. Paper presented at the 4th International Crop Science Congress, Australia.

Boer, R., M.I. Wahab, Mugni, H. Harjanto, and Nuryadi. 2004. Reducing climate risk for potato and chili production at Pengalengan, Bandung District, West Java. Project Report submitted to START.

Boer, R., M.K. Rahadian, and Perdinan. 2003. The use of agriculture system modeling for crop management: Case study at Pusaka Negara. Technical Report submitted to Asia Pacific Network.

Boer, R., Wahab, I., and Perdinan. 2004. The use of global climate forcing for rainfall and yield prediction in Indonesia: Case study at Bandung district. Paper presented at the 4th International Crop Science Congress, Australia.

Coughlan, M.J. 1988. Seasonal climate outlook. The Changing Climate and Central Queensland Agriculture. E.R. Anderson (Ed). Brisbane, Australia.

Clewett, J.F., O.S. Hwang, D.T. Owens, D.A. George, and I.J. Partridge. 2002. RAINMAN International Software. Australia: ACIAR and Department of Primary Industry.

Clewett, J.F., S.M. Howden, G.M. McKeon, I.J. Partridge, and J.C. Scanlan. 1991. Use of systems analysis and the southern oscillation index to optimize management of grain sorghum production from a farm dam irrigation system. Climatic Risk in Crop Production: Models and Management for the Semiarid Tropics and Sub-tropics. R.C. Muchow and J.A. Bellamy (Eds.). Wallingford, United Kingdom: CAB International. 307-328 pp.

Epstein, E.S. 1991. On obtaining daily climatological values from monthly means. *Journal of Climate* 4: 365-368 pp.

FMS. 2003. ENSO Impact on sugarcane in Fiji. Fiji Meteorological Services, Sugarcane Research Centre of the Fiji Sugar Corporation, and the Pacific Centre for Environmental and Sustainable Development of the University of the South Pacific, Fiji.

Hammer, G., B. Keating, H. Meinke, P. Carberry, D. Freebairn, M. Probert, and D. Holzworth. 1999. An integrated systems approach to improving agricultural systems using the agricultural production systems simulator, APSIM. Proceedings of International Symposium on Modelling Cropping System. European Society for Agronomy, Division of Agroclimatology and Agronomic Modelling, June 21-23, 1999, Lleida, Spain, 31-37 pp.

Hammer, G.L. and N. Nicholls. 1996. Managing for climate variability: The role of seasonal climate forecasting in improving agricultural systems. Proceedings of the Second Australian Conference on Agricultural Meteorology. Melbourne, Australia: Bureau of Meteorology, Commonwealth of Australia. 19-27 pp.

Jones, J.W. 2003. Agricultural response to climate variability and climate change. Background paper for NOAA Workshop on Insight and Tools for Adaptation: Learning from Climate Variability. Washington, D.C, November 18-20, 2003. http://www.climateadaptation.net.

Jones, R., R. Boer, S. Magezi, and L. Mearns. 2003. Assessing Current Climate Risk. Technical paper for Adaptation Policy Framework. United Nation Development Program. http://www.undp.org/cc/apf_outline.htm.

Meinke, H., S. Power, R. Allan, and P. deVoil. 2001. Can decadal climate variability be predicted? Final Report to Land and Water Australia. Australia: Agriculture Production System Research Unit (APSRU), Bureau of Meteorology (BoM), and Queensland Government Department of Primary Industry.

Meinke, H. and Z. Hochman. 2000. Using seasonal climate forecasts to manage dryland crops in northern Australia: Experiences from the 1997/98 seasons. Application of seasonal climate forecasting in agriculture and natural ecosystems. The Australian Experience. G.L. Hammer, N. Nicholls and C. Mitchell (Eds.). Kluwer Academic.

Meinke, H. and R. Stone. 2003. Seasonal and interseasonal climate forecasting: The new tools for increasing preparedness to climate variability and change in agricultural planning and operation. Paper submitted to *Climate Change.*

Messina, C.D., J.W. Hansen, and A.J. Hall. 1999. Land allocation conditioned on El-Niño-Southern Oscillation phases in the Pampas of Argentina. *Agricultural Systems,* 60: 197-212 pp.

Rosenthal, K.M. and G.L. Hammer. 1978. Frost probabilities in Queensland. *Queensland Agriculture Journal,* 104: 177-201 pp.

Saji, N.H., B.N. Goswami, P.N. Vinayachandran, and T. Yamagata. 1999. A dipole mode in the tropical Indian Ocean. *Nature,* 401: 360-363 pp.

Strong, W.M. 1981. Short term fertilization of winter crops. Brisbane, Australia: Proceedings of the Queensland Crop Production Conference, Queensland Department of Primary Industry.

Stone, R.C. and A. Auliciems. 1992. SOI phase relationships with rainfall in eastern Australia. *International Journal of Climatology,* 12: 625-636 pp.

Stone, R.C., G.L. Hammer, and T. Marcussen. 1996. Prediction of global rainfall probabilities using phases of the Southern Oscillation Index. *Nature,* 384: 252-256 pp.

Woodruff, D.R. and J. Tonks. 1983. Relationship between time of anthesis and grain yield of wheat genotypes with differing developmental patterns. *Australian Journal of Agricultural Research,* 34: 1-11 pp.

Yamagata, T., A. Karumuri, and G. Zhaoyong. 2001. Indian Ocean Dipole Phenomenon's Impact on Correlation between Indian Monsoon and El Niño/Southern Oscillation. NASDA and JAMSTEC. http://www.jamstec.go.jp.

APPENDIX 1. List of Members of the
RA-V Working Group on Agricultural Meteorology
(XIII-RA V)

Country	Address	Contact
Australia	Bureau of Meteorology 83 Carnarvon Road STRATHMORE, VIC 3041 Australia	Mr. Russell Stringer Tel.: (+ 61-3) 9379 4641 (H)/9669 4225 (W) E-mail: r.stringer@bom.gov.au
Fiji	Fiji Meteorological Service Private Mail Bag, NAP 0351 NADI AIRPORT, Fiji	Mr. Simon McGree Tel.: (+ 67-9) 6736038 Fax: (+ 67-9) 6736047 E-mail: Simon.McGree@met.gov.fj
Indonesia	Dept of Geophysics and Meteorology FMIPA – Bogor Agricultural University Jalan Raya Pajajaran BOGOR 16144, Indonesia	Mr. Rizaldi Boer Tel.: (+ 62-251) 376817 Fax: (+ 62-251) 313384/376817 E-mail: rboer@fmipa.ipb.ac.id or rizaldiboer@yahoo.com
Malaysia	Malaysian Meteorological Service Jalan Sultan 46667 PETALING JAYA, SELANGOR Malaysia	Mr TAN Lee Seng Tel.: (+ 60-3) 7967 8221 Fax: (+ 60-3) 7955 0946 E-mail: tls@kjc.gov.my
New Zealand	National Institute of Water and Atmospheric Research (NIWA) P.O. Box 109-695 Newarket, AUCKLAND New Zealand	Dr M.J. Salinger Tel.: (+ 64-9) 375 2053 Fax: (+ 64-9) 375 2051 E-mail: j.salinger@niwa.com or j.salinger@niwa.co.nz
Papua New Guinea	PNG National Weather Service P.O. Box 1240 BOROKO, NCD 111 Papua New Guinea	Mr Kasis Inape Tel.: (+ 67-5) 325 2788 Fax: (+ 67-5) 325 5201/325 2740 E-mail: kinape@pngmet.gov.pg or kinape70@yahoo.com
Philippines	Weather and Flood Forecast Centre Philippine Atmospheric, Geophysical and Astronomical Services Administration Agham Road, Dilima Quezon City, 1101, Philippines	Mr. Bonifacio G. Pajuelas Tel.: (+ 63-2) 929 4865 Fax: (+ 63-2) 929 4865 or 926 3151 E-mail: odstaff@pacific.net.ph or bjpajuelas@pagasa.dost.gov.ph
Philippines	Philippine Atmospheric, Geophysical and Astronomical Services Administration 3rd Flr. Asia Trust Bank Bldg. 1424 Quezon Avenue QUEZON CITY, Metro Manila Philippines	Mrs. Flaviana D. Hilario Tel.:(+ 63-2) 373 3427 Fax:(+ 63-2) 373 3433 E-mail: fhilarioph@yahoo.com or fhilarioph@yahoo.com
Vanuatu	Vanuatu Meteorological Service PMB 9054 PORT VILA Vanuatu	Mr Kaniaha Salesa Nihmei Tel.: (+67-8) 23866 or 24686 Fax: (+67-8) 22310 or 22745, 27414 E-mail: kaniaha@yahoo.com.au or skaniaha@meteo.vu

APPENDIX 2. Questionnaire sent to WMO Members of RA-V

1	Does the Meteorological Service of your country have an independent Agrometeorological Service Unit?
2	Who are the major customers for Agrometeorological services in your country?
3	What kind of operational Agrometeorological services are provided by the NMHS (National Meteorology and Hydrology Service) in your country?
4	What are the operational services provided by the Meteorological Service in your country?
5	What are the shortcomings and limitations of your work?
6	Do you work with agricultural research and extension services in your country?
7	Are you aware of the new requirements from the following International Conventions and Agreements (UNFCCC, UNCCD, CBD, World Food Summit Plan of Action)?
8	What additional activities, methods, and tools could help you improve the operational Agrometeorological services in your country?
9	What strategy should be employed to build the capacity of your service to strengthen operational agrometeorological services in your country?

APPENDIX 3. Questionnaire Responses from RA-V

No	FIJI	INDONESIA
1	No	Yes, just established in 2003 under Agroclimatology and Air Pollution Division at the BMG. Department of Agriculture also has Research Agency on Hydrology and Agroclimate
2	The Fiji Sugar Corporation, Ministry of Agriculture-government and individual farmers	Agriculture offices (local government), Department of Agriculture, Ministry of Forestry, Ministry of Environment, and National Task Forces
3	Issuing regular Bulletin on Seasonal Climate Prediction Issuing early warnings/alerts as appropriate Helping with strategic studies such as agroecological zoning Assessing impact of extreme events such as floods, cyclones, etc.	Issuing regular Bulletin on Seasonal Climate Prediction Issuing early warnings/alerts as appropriate such as flood, forest fire, and drought Helping with strategic studies such as agroecological zoning in collaboration with other agencies
4	Services to help reduce the impact of natural disasters, including pests and diseases Early warning and monitoring systems Short- and medium-range weather forecasting for agriculture Climate prediction/forecasting for agriculture	Early warning and monitoring systems Short- and medium-range weather forecasting for agriculture (weather Modification); Climate prediction/forecasting for agriculture (for vulnerable districts)
5	Meteorological and sugar data is good however there is little yield and production data for other crops Do not have climatological staff trained in statistical analysis Have problems getting correct and useful information to the farmers	Many rainfall stations are not in operation. Only 35 percent of the total is in operation and data transferring system from local to headquarters is not timely. Many stations have discontinued data records. Do not have dynamic-based climate forecast models, numerical models Skill for downscaling global climate forecast into local forecast is still low Local authorities/farmers are not able to use climate (forecast) information issued by the BMG Lack of staff with strong statistical and agrometeorological background

APPENDIX 3. Questionnaire Responses from RA-V (Cont.)

No	FIJI	INDONESIA
6	Yes, but irregular	Yes, but irregular. It is expected that the local authorities and agriculture extension has capacity to translate the climate forecast information for end users (in particular farmers). Climate Field School is being developed in collaboration with Bogor Agricultural University, local agriculture office, and Directorate of Plant Protection. It is intended to help farmers use climate (forecast) information for crop-management strategies
7	No	Yes
8	Provide adequate training opportunities for meteorological staff in agrometeorology and statistics Provide funding for training and research	--Have access to satellite data, General Circulation Models (GCMs) outputs, downscaling models, and other simulation models (crop simulation models) --More training opportunities for meteorological staff in agrometeorology and statistics --Have more staff at the Baden Meteorologi dan Geofisika (BMG) with strong background in agrometeorology, statistics, and simulation modeling
9	No answer	--Improve computing facilities (super computer) --Increase number of climate/weather observation networks (particularly rainfall) --Improve skill of climate forecast through the use of dynamic and statistical models --Provide training for Meteorological staff in simulation modeling and statistics --Develop maps of vulnerable areas to extreme climate events --Develop better (drought, flood, forest fire) monitoring system, such as using satellite) --Strengthen collaboration with local authorities (Agriculture Office) to capacitate extension workers to translate climate information for farmer use --Develop new bulletins/newsletters on agrometeorology tailored to specific user needs and further development of web-site for agrometeorology services Improve climate data transfer systems from local to headquarters office and develop better skills for climate forecast

APPENDIX 3. Questionnaire Responses from RA-V (Cont.)

No	MALAYSIA	PHILIPPINES
1	Yes	Yes
2	The Agriculture Department, Agriculture Research Institute, The Rice Institute, Rubber Research Institute, Forest Research Institute, Palm Oil Research Institute and the Agriculture Research Institute, and the farmers	Department of Agriculture, fertilizer company, farmers
3	Issuing regular bulletin on seasonal climate prediction Issuing early warnings/alerts as appropriate Helping with strategic studies such as agroecological zoning Assessing impact of extreme events such as floods, cyclones, etc.	Issuing regular bulletin on seasonal climate prediction Issuing early warnings/alerts as appropriate Helping with strategic studies such as agroecological zoning Assessing impact of extreme events such as floods, cyclones, etc.
4	Early warning and monitoring systems Short- and medium-range weather forecasting for agriculture Climate prediction/forecasting for agriculture (for vulnerable districts)	Early warning and monitoring systems Short- and medium-range weather forecasting for agriculture Climate prediction/forecasting for agriculture Services to help reduce the contributions of agricultural production to global warming
5	Current availability of data adequate but needs better coverage Analytical tools lacking Methods of provision of operational agrometeorological services needs to improve	Some important agrometeorological data are not being observed/measured (soil moisture, evapotranspiration, etc.). There is weak communication link with farmers. Radio programs could facilitate the timely broadcast of the agrometeorological forecast.
6	Yes, but irregular	Yes, but irregular
7	Yes	No (Partly)
8	NDVI Remote sensing tools and methodologies GIS Other Agrometeorological methodologies	The utilization of remotely sensed data in operational agrometeorological services. Development of yield forecast model
9	Training and to acquire technical skills	Improvement of data collection Capacity building on yield forecast modeling

APPENDIX 4. Proposed List of Questions from Philippines

Country Name: ____

List the name/s of existing model/s describing the relationship between weather and agriculture (such as pests/diseases). Indicate whether this is operational or not.

		Operational?
1.	____________________	__Yes __No
2.	____________________	__Yes __No
3.	____________________	__Yes __No
4.	____________________	__Yes __No
5.	____________________	__Yes __No
6.	____________________	__Yes __No
7.	____________________	__Yes __No
8.	____________________	__Yes __No

Indicate the title of paper(s)/publication(s) describing the model including the source. (Please indicate the internet address where these papers can be viewed.)

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When did these models become operational?

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What are the skills of these models?

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Please list the name of contact person including e-mail address/phone number.

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