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Department of Science & Technology, Government of India,
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Under Section
A. Sensor Networks & Web Enablement (SWE)

: ***Title of the Project*** **:**

Web Enabled and Weather Based Decision Support System for Fore-warning and Management of YSB and BPH of Rice in Andhra Pradesh

Submitted By

Dr. V Radhakrishna Murthy, *Principal-Investigator*
Dr. P V Krishnayya, *Co-Principal Investigator*
Dr. D V Sai Ram Kumar, *Co-Investigator*-I
Dr. Chavan Syam Raj Naik, *Co-Investigator*-II

ACHARYA N.G. RANGA AGRICULTURAL UNIVERSITY
HYDERABAD – 500 030

PART I
(General Information)

11.0 Project Title	**:**	**Web Enabled and Weather Based Decision Support System for Fore-warning and Management of YSB and BPH of Rice in Andhra Pradesh.**
11.1 Priority Area and Sub-area	**:**	NRDMS, DSS, GIS, and Remote Sensing
11.2 Duration (in months)	**:**	24 months from October 2014
11.6c Address	**:**	Agricultural College,Department of Entomology, ANGRAU,BAPATLA–522 101, Guntur District, Andhra Pradesh

PART II
(Project proposal)

12.0 Project summary:

In "Soil-Plant- Weather Continuum", both soil and plant contain "Water" and "Air". Therefore, these two have "Life" and scientific terms "Soil health" and "Plant health" are in vogue. However, both "Water" and "Air" are "Weather elements". Therefore, weather has "Life" and "Weather health" for crop production is defined as "The potential force through which weather elements perform their several and cooperative functions optimally for better crop health to produce potential yields". Based on "Weather health" conditions, the management options for all agricultural operations including plant protection measures can be adopted by the farmers (Murthy and Reddy, 2009).

"Weather health" is one of the most crucial prerequisite for successful incidence of insect pests as their bionomics is intimately related with congenial weather parameters. In addition to the crop, the insect pests also require specific number of "Growing Degree Days (GDD), Helio Thermal Units (HTU) and PhotoThermal Units (PTU) for successful completion of their growth stages. Therefore, the incidence of insect pests can be well predicted by studying the weather health.

Weather based forewarning of crop insect pests provides necessary information regarding timing and intensity of the pest infestation. This helps in taking up timely cost effective and eco-friendly integrated pest management (IPM) measures. For successful implementation of IPM, forewarning or forecast of the pest is a pre-requisite (Murthy, 2012).

Yellow Stem Borer [YSB, *Scirpophaga incertulas* (Walker)] and Brown Plant Hopper [BPH, *Nilaparvata lugens* (Stal)] start occurring on rice crop during the vegetative stage. It is possible that the "Weather health" prior to and during this stage of the crop is significant for the growth and multiplication of these pests, leading to economic threshold level or peak populations in the succeeding months during which the crop will be in its late vegetative or even early reproductive stage. Hence, it is expected that "Weather health" quantified in terms of GDD/HTU/PTU upto and from vegetative stage might give some meaningful indication about threshold level or peak populations of these pests likely to be reached duing the succeeding months. Keeping this in view, accumulation of GDD/HTU/PTU will be arrived as suggested by

Chakravarthy and Gautham (2002), who were successful in developing weather based forewarning models / rules for indication about the qualitative level of infestation of mustard aphid well before a month of its economic damage.

In this context, a **hypothesis is proposed for this investigation:** "YSB and BPH populations on rice may be more in a year when GDD accumulation is slower (around 100 degree days) and *vice- versa* when faster (150 degree days) from and upto late vegetative / early rproductive stage of rice crop.

IF WEATHER HEALTH IS GOOD, THE DAMAGE BY YSB AND BPH IS LESS AND *VICE- VERSA*.

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A decision support system (DSS) integrating forewarning and pest management called GDD/HTU/PTU CALCULATOR in rice (Paddy: *Oryza sativa* L) of the two major insect pests viz., YSB, *S. incertulas* and BPH, *N. lugens* will be developed using Geographical Information System (GIS) interface. To extend the area i.e., special resolution / coverage of the DSS, the Remote Sensing techniques will be explored. A dedicated website will be launched to provide the necessary information on pest situation (current and next week's) and necessary plant protection advisories for the benefit of the farmers/ UG & PG students/ Polytechnic students/ policy and decision makers. These advisories will be issued as made available in the book "WEATHER-AGRICULTURE" (Murthy and Reddy, 2009&Murthy, 2012) and also based on research recommendations of ANGRAU and other national research centers in coastal Andhra Pradesh through GIS maps, internet, mobile phones and kiosks. Direct interaction will be done with farmers/ UG&PG students/ Polytechnic students/ policy and decision makers.

Key words: Weather-based, web-enabled, decision support system, insect pests, rice, GIS, RS, GDD/HTU/PTU Andhra Pradesh.

12.1 Objectives:

1. To quantify the "Crop - Insect Pest – Weather" relationship in rice using available historical and current information on weather of two major insect pests of rice i.e., YSB, *S. incertulas* and BPH, *N. lugens*
2. To develop a DSS viz., GDD/HTU/PTU calculator for forewarning and management of the insect pests (YSB & BPH) of rice and,
3. To develop a user friendly website for direct interaction with rice farmers and other stake holders to address the YSB & BPH problems of rice in coastal Andhra Pradesh.

12.2 Problems intended to be addressed by the proposed project:

Rice is one of the most important major cereal crops which provides staple food for more than half of the world's population. In India, rice occupies an area of 44.6 m. ha. with an average productivity of 2090 $kg.ha^{-1}$. In Andhra Pradesh, it is grown in an area of about 3.82 m. ha with an average productivity of 2980 $kg.ha^{-1}$occupying fourth place in the area and first in production (Norman Uphoff, 2002).

Weather has tremendous influence on outbreak of pests and diseases of crop plants. A study carried out by Rockfeller foundation (Herdt, 1991) revealed that seven out of 20 major

challenges in rice production are insect pests. Among the biotic stresses, insect pests cause about 10-15% yield loss. The average yield loss in rice has been estimated to vary between 21-51 per cent. The YSB and BPH are the key pests in rice inflicting 25-30%, 10-70% yield losses respectively. At national level, stem borers accounted for 30% of the losses, while plant hoppers (20%), gall midge (15%), leaf folder (10%) and other pests (25%). Depending upon the age of the crop, the incidence of insect pests and resultant yield losses vary significantly. During the first 30 days after transplanting significant yield losses are reported due to stem borer and gall midge only in 10-15% of the locations tested under AICRIP. The crop growth period between 30-60 days after transplanting is the most vital period and at the same time highly vulnerable to biotic stresses resulting in major yield losses (20-68%) mainly due to stem borer, gall midge, leaf folder and brown plant hopper. Beyond sixty days after transplanting, the crop damage caused by stem borer and leaf folder result in 10 to 48% damage.

This phenomenal loss can be minimized by integrated pest management (IPM) backed by an efficient forewarning system. Hence, some efforts were made to develop forewarning models for insect pests of paddy using regular weather data from meteorological observatories. However, recommendations regarding pest and disease management using pest and disease forecast are limited.

Collection and transmission of data to a forewarning modeler to run a model to generate forewarning, then in turn to the pest management experts finally to disseminate management strategies to the farmers takes too long a time when human factors are involved and by then sufficient crop damage would have already been rendered by these biotic factors.

Therefore, a quick and timely decision support system for forewarning and development of a management strategy for major insect pests is the immediate need of the hour to the rice farmers by automating the data collection to forewarn in the bare minimum time possible, through a dedicated website for the purpose.

Hence, the present project is proposed for development of a decision support system to cater the needs of the rice growers in coastal Andhra Pradesh.

12.3 Concerned parties/ target users of the output of proposed project: Farmers, Policy makers and Administrators of agricultural Department of Andhra Pradesh

12.4 Who has identified the problem and its relevance to the objectives of NRDMS Project?

Principal Investigator, Dr. V Radha Krishna Murthy, Professor of Agronomy (Agricultural Meteorology) along with Dr. P V Krishnayya, Professor of Entomology, Acharya N Granga Agricultural University, Hyderabad, Andhra Pradesh have identified the problem under the following circumstances.

Rice cultivation extends from 8^{O} to 35^{O}N latitudes across diverse ecosystems such as irrigated (52.6%), upland (12%), rain fed low land (32.4%), semi deep water and deep water (3%) as well as coastal saline regions. Based on the water availability rice is taken up as a single crop or as high as three crops in a year. With the introduction of changes in varieties being cultivated, practicing of different cultivation systems and concomitant alterations in rice based

cropping systems, certain pests which were earlier regarded as minor pests have now assumed significance as pests of regional significance. Various rice based cropping systems prevalent in different areas are rice-rice-rice, rice-rice-pulse, rice-pulse, rice-wheat, rice-rice-vegetables, rice-sugarcane, rice-rice-fallow, rice-fallow, rice-mustard, rice-maize, rice-potato-summer rice, rice-oil seed, rice-other crops-winter jhuming etc. Among all the above mentioned systems, rice-wheat cropping system is the major system in the country occupying 9.8 million hectares (Yadava and Subba Rao, 2001) followed by rice-rice (5.9m ha) and rice fallow (4.4m ha). In this context, there is a change in resource utilization pattern and also pest dynamics within diverse ecologies or cropping systems. Among the cropping systems, the insect pest problems are relatively more in rice-rice-rice or rice-pulse than rice-maize or rice –wheat cropping systems. Among the different ecologies, irrigated ecology harbors more number of insect pests.

In the present context of plant protection scenario in rice, many farmers adopt schedule based application of chemical pesticides against insect pests and diseases as per the suggestions of pesticide dealers and neighboring farmers. These are fixed spray schedules and are not supported by any pest forewarning systems which finally culminate to development of pest resurgence, pesticide resistance and residues besides the environmental hazards. On the other hand, resource poor farmer cannot afford the recommended spray schedule due to high cost involved in it and the crop often gets damaged by insect pests. Hence, there is an imminent need for a real time IPM driven by different tactics (biopesticides/ biocontrol agents/ physical and cultural interventions/ chemical pesticides) based on early warning system of pests.

Some initiative has been done in this direction already and lot more needs to be done in this line. A mission mode NATP project (ICAR) entitled ‘Development of weather based forewarning system for crop pests and diseases’ was carried out during 2001-04 at Central Research Institute for Dry land Agriculture (CRIDA) Hyderabad as nodal centre. Forewarning systems of six major pests and diseases of six crops, namely – cotton, rice, mustard, chickpea, pigeonpea and groundnut were addressed. Agricultural physics Division of IARI was one of the coordinating centers involved in development of forewarning system of major insect pests and diseases of mustard. CRIDA is involved in an NAIP (ICAR) project, ‘Development of Decision Support Systems for Insect Pests of Major Rice and Cotton based Cropping Systems’.

This is a project through which the output, forewarning and remedy of YSB and BPH on rice will be delivered to the farmers/pest managers directly through internet/mobile phone/kiosks.

12.5 How will the project’s output dovetail into the overall development strategy?

The loss of yield (to the extent of 30-40%) can be minimized through prior intimation regarding possible outbreak of the insect pests and remedial measures to be taken. There will be minimal use of toxic chemical pesticides. Cost of plant protection will be reduced and benefit-cost ratio of rice cultivation will be improved. Environment will be protected from hazardous pesticide loads.

12.6 What are the likely impacts on various sections of the society in the area or neighbouring areas? : Reduces cost of cultivation of crops by 10%; Improves the quality of the crop produce by 3-5 %;Improves the livelihoods of rural population in Andhra Pradesh

12.7 Expectations/ estimation when the project will become self-sustaining

On receiving weather forecast (5 days in advance) from IMD twice in a week, experts of different agricultural disciplines sit together and give recommendations which are put on the website and also sent to the farmers through telephones. The DSS to be developed in this project can be part of the advisory after completion of the project. The back ground is ready for its sustenance.

12.8 Review status

12.8a Pre-project status:

International status: To facilitate decision making at farm and policy levels decision support system for agro-technology transfer (DSSATT) was developed in USA. It allowed rapid assessment of several agricultural production systems in the world. Development of stand alone decision support systems for pest components could lead to their practical use. In developed countries, dynamic websites that include interactive models, GIS based decision systems; real-time weather and market information are being rapidly developed and are made available in the internet (www.effita.net) to enable farmers for real time use in crop management.

The 'SIRATAC' was one of the earliest decision support systems which was used in Australian cotton industry from 1976 to 1993 to reduce the risk associated with pest management using chemical pesticides. This was developed by CSIRO in collaboration with University of Western Sydney, Australia. The EntomoLOGIC decision tool is derived from the SIRATAC and is now in vogue. 'PESTMAN model' was also developed to forecast the timing of activity of number of pests of field crops and forecast for cabbage root fly and carrot fly and is available to growers as a weekly mail. A suite of predictive models (MORPH) has been developed at Horticulture Research International, UK. Web based models and decision support systems are increasingly becoming popular and may become an absolute need and requirement in future for local, regional and international implementation of IPM systems. In Australia, HEAPS model was developed, aiming at managing *Helicoverpa armigera* Hub. in cotton. This model incorporates modules based on adult movement, oviposition, development, survival and host phenology and estimates population in geographic grid units. A multivariate regression model of historical data was used to develop incidence-forecast model built with fuzzy integrated decision making theory in China. In USA and the Netherlands, commercial farms are applying meso-scale modeling techniques to forecast insect development and producing grided products for regional and on farm planning and pest management. Hu (1993) reported ESRICE - a decision support system for forecasting and management of *Nilaparvata lugens* and *Cnaphalocrosis medinalis* from China. Another expert system / decision support system 'HOPPER' was developed for forecasting the risk of white backed plant hopper, which involved many factors like immigration level, weather conditions during winter and during immigration, rice variety, plant vigour, natural enemies and local weather conditions for forecasting.

National status: Decision support system exclusively for insect pest and disease management of rapeseed and mustard is not reported in India. However, AAQUA (almost all questions answered) is a website run by KVK Baramati which addresses the plant protection queries along with other agriculture, horticulture, and animal science related questions through the question-

answer mode. When a question is put forward by the farmers/end user, the answer will be given by the expert related to the KVK through website. Another website is 'e-SAAGU' operated from Hyderabad. It has a dedicated module regarding crop pest management but not yet started functioning.

Although a complete or full-fledged DSS or expert system is not available, much work was done on forewarning of insect pests and diseases of mustard. Forewarning of aphid, *Lipaphis erysimi* using weather parameters was reported by Chakravarty and Gautam (2002) and Kar and Chakravarty (2000). Nirmala Devi *et al*.(1995) observed that low rainfall during 3rd week of February enhanced aphid population in 4th week of February. Several workers (Rana *et al*., 1993; Raj and Sharma, 1991) reported the rainfall as a reducing factor of aphid population. Cloudiness has some positive impact on aphid multiplication (Bishnoi *et al.*, 1992). Ahuja (1990) found a negative correlation of aphid incidence with temperature and sunshine hours in Rajasthan. Sinha *et al*. (1989) reported a decrease of minimum relative humidity below 50.9% ceased the pest activity. Retrieval of near surface weather parameters through satellite remote sensing to forecast the mustard aphid is reported by Bhattacharya *et al* (2006) and Dutta *et al* (2008). Forecasting of white rust disease was reported by Gopal Kumar and Chakravarty (2008). The reported results in the development of pest and disease forewarning systems of rapeseed-mustard form valuable information in this project and will be used after validation.

12.8b End-project status:

A decision support system for forewarning and management of important insect pests of rice in Andhra Pradesh provides information on pest situation to farmers and pest managers directly one week ahead. The farmers will come to know whether or not any pest attack is there in the offing. If the pest attack is predicted, the farmers will get a head time of at least one week to get prepared (collection of biocontrol agents /purchase of insecticides and insect traps as per recommendation). They will also get ready-made recommendation based on IPM method, input requirement (chemical/ biological/ cultural) or dosage and time of application of the inputs. This system will save time and money for farmers and protect the environment as a whole.

13.1 Approaches / Methodologies for the work plan:

Crop : Rice (*Oryza sativa* L.)
Pests : Yellow stem borer (YSB), *Scirpophaga incertulas* (Walker);
Brown plant hopper (BPH), *Nilaparvata lugens* (Stal) and
Location: Department of Entomology, Agricultural College, BAPATLA – 522 101, Acharya N.G. Ranga Agricultural University, Andhra Pradesh.

<u>Objective: 1.</u> To quantify the "Crop - Insect Pest – Weather" relationship in rice using available historical and current information on weather and two major insect pests of rice (YSB, *S. incertulas* and BPH, *N. lugens*).

A. **Current weekly data on incidence of the insect pests:** Incidence of the insects either from the light trap or from sex pheromone traps and from the field, and the data on damage occurrence will also be collected

- Historical data on the mentioned aspects will also be collected from the respective ANGRAU research stations and from the Directorate of Rice Research, Hyderabad.
- Population dynamics of the insect pests of rice will be prepared for entire season.

B. Current data on weather parameters: Data on weather parameters will be obtained from ANGRAU research/educational/extension units, also, from the available sources viz., WMO/IMD/Mass-Media (news papers/TVs/ etc.)

C. Crop-Pest – weather interaction study:

1) Historical data on the mentioned pests of rice and weather parameters will be analyzed using statistical methods (Multiple/ Stepwise regression/ Gomphrez curve). Crop phenology and natural enemy data will be incorporated for better accuracy.
2) Murthy's Comparision Concept (MCC): Murthy's "Comparison Concept" (2002 and 2006) takes into account the weather/climate forecast issued in real-time basis, its derived parameters (GDD, HTU, PTU etc.,) as the basis for forewarning. These real time forecasts and derived parameters are compared with the scenario of past seasons or years and a suitable set of common similarities on levels of pest-incidence and crop performance are arrived. This information helps to produce future scenario of occurrence of the pests, crop yield etc., in addition to determine the levels of incidence of the targeted insect pests and projected crop yield in the ongoing season. This concept can be used to develop or extrapolate a thumb rule / dynamic simulation model / empirical model to produce future scenario of occurrence of the pests and the subsequent crop yield etc.

D. **Development and validation of insect pest forewarning models:** From the above analysis, weather-based models for forewarning of the above mentioned insect pests will be developed. Sensitivity analysis, parameterization and validation of forewarning models will be carried out with data generated. The existing forewarning models for these pests will also be reviewed, suitably modified and adopted after sensitivity analysis, parameterization and validation with current data of IARI and NCR. Growing degree day (GDD) models will be developed for crop and pest phenology forecasting.

E. **Development of software:** Computer software will be developed for forewarning of these insect pests.

<u>Objective 2.</u> To develop a DSS viz., GDD/HTU/PTU calculator for forewarning and management of the insect pests of rice in coastal Andhra Pradesh

A. Preparation GDD/HTU/PTU calculator: A GDD/HTU/PTU calculator will be developed using the weather data of the last 30 years**.**If required Digital maps will be generated using ARC-GIS.

B. Incorporation of forewarning software: The **GDD/HTU/PTU calculator** i.e., the software thus developed will be used to calculate the population density/level of the mentioned insect pests one week in advance. Transmitted real time weather data from each research stations of ANGRAU/IMD collected insect pest data, crop phenology and natural enemy data will be used for this purpose. District level weather forecast data available from IMD will also be utilized.

C. Incorporation of pest management options: Predicted insect pests' situation will be

available one week in advance from GDD/HTU/PTU calculator, the forewarning software. Management options like whether or not to use any intervention, if any intervention (based on IPM principle) is required, the decision regarding type of intervention (chemical /biological/cultural), dosages and time of application will be decided. These management options for the insect pests will be incorporated in the GDD/HTU/PTU calculator i.e., the DSS (Decision Support System) using standard crop protection manuals and with the help of two associates and other plant protection personnel.

D. **Murthy's Daily Weather and Agriculture (MDWA)**: In this Concept the "Daily news papers" and hand outs entitled "Daily weather- Agriculture" are effectively used. In the hand outs, the management options and advice that a farmer has to take / follow for agricultural operations based on weather data observed in the news papers is made available. First, the paper clippings for the last 30 days on weather data have to be pasted on the white sheets by the farmers. They may be requested to observe the trends of weather and based on these trends (analysis of weather data) the farmers may be asked to take up decisions / follow the intelligent management options and guidance for the success of their crops/ agricultural operations from the hand outs on "Daily weather- Agriculture". This huge and valuable information on weather and operational management options and guidance that is available in their own village definitely triggers enthusiasm among the farmers. The farmers may be requested to continuously do the same on their own for their own farm and also for the benefit of the entire community in a village as a whole. Also, the farmers may copy/write the weather information available daily on Television and Radio and transmit / exchange the same with other farmers, which will add further to the quality of weather data. This operational agro-meteorological tool "Daily Weather and Agriculture" (in local language, "Dinasari Vatavaranam- Vyasayam") involves no money because the newspapers are bought by villagers / farmers for learning and enlightening themselves on several issues. Also, in India and Andhra Pradesh newspapers are very inexpensive and Television and Radio are available in all villages.

E. **Growing Degree Days (GDD)**: In "Weather health" and "Daily weather and agriculture" concepts, as also in the preparation of "Weather- Agriculture" book (Murthy and Reddy 2009) and technical handouts in local Telugu language, in addition to rainfall probabilities the GDD concept was successfully used. By definition "Degree days are summation of mean temperatures over a base temperature (Nuttonson, 1955). The GDD is also known as "Heat units" "Thermal units" "Effective heat units" "Growth units" etc. The accumulations are made on daily basis and are also accumulated between any two phenological events of crop plants or dates McMaster (1997) and Chakravarty and Gautham (2002).

The concept assumes that:

- There is a direct and linear relationship between growth of a crop plant and air temperature (Nuttonson, 1955).
- A crop requires a definite amount of accumulated heat energy for optimum crop yields (Chakravarty and Gautam, 2002).
- The biotic potential of an agricultural crop plant is dependent on the heat requirement for its growth, development, reproduction, grain yield etc (Pruess, 1983)

The canonical form prescribed by McMaster (1997) for calculating GDD is

$$\text{Degree Days } (^0D) = \{(T_{max} + T_{min})/2 - T_{base}\}$$

Where:

- "T max" and "T min" represent the daily maximum and minimum temperatures respectively.
- "T base is the base temperature

Usually Degree Days are expressed as "^{0}D" to distinguish from temperature units

The base temperature: It is the one below which the internal metabolic activities of crop plant cease to function. Though the base temperature varies from crop to crop, it is constant for a specific crop. In India, during *Kharif* season (South West monsoon crop season) the base temperature is taken as 10 degrees centigrade and for *Rabi* (North east monsoon season crop) the base temperature is taken as 5 degrees centigrade (Murthy, 2002 A).

Advantages / Importance of GDD

The GDD is a small and simple concept of relating plant growth, development and maturity to the air temperature. The growth of a plant is dependent on the total amount of heat to which it is subjected during its life time.

The GDD are useful in many ways:

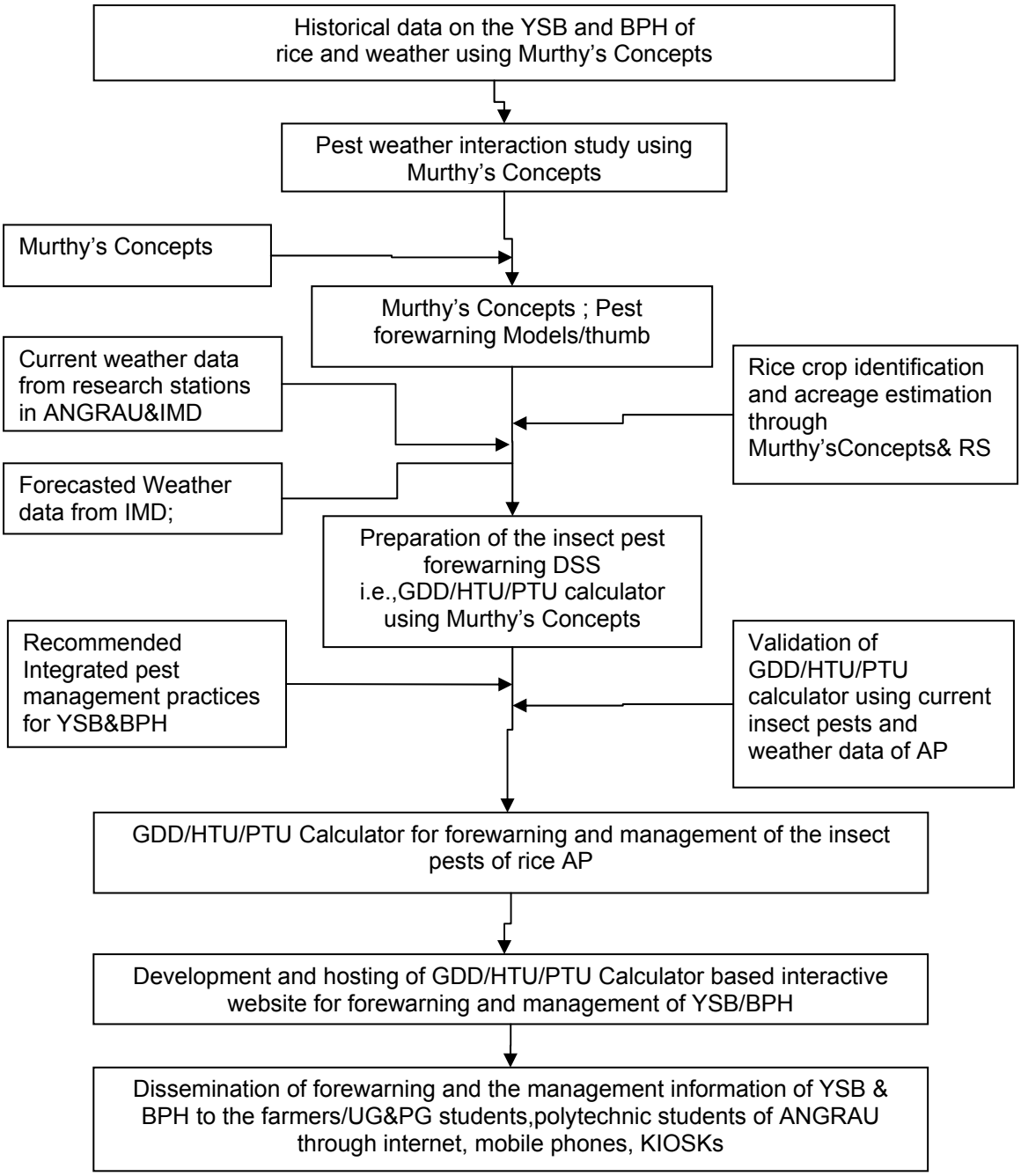
- In guiding all the agricultural operations, land use planning etc.
- To forecast crop harvest dates, yield and quality
- In forecasting labour required for agricultural operations
- Introduction of new genotypes in new areas
- In predicting the likelihood of successful growth of a crop in new areas

<u>Objective 3.</u> To develop a user friendly website for direct interaction with rice farmers and other stake holders to address the insect pest problems of rice in coastal Andhra Pradesh (GIS/RS etc., technics will be used).

A. Development and hosting of a dedicated website for decision support system: An exclusively dedicated website for the purpose will be developed for providing information regarding present and weekly advancement of infestation levels of the insect pests and their management practices as per situation. The GDD/HTU/PTU CALCULATOR is the key AGROMETEOROLOGICAL TOOL that plays major role on the web site.Development of website will be outsourced to one suitable agency. It will have two major windows *viz*., map window and interactive window. The map window will have readymade information in the form of digital map on rice growing areas in the mentioned localities of AP, weather station locations, weather parameters, current levels of each pest, (once in a week in advance) and recommended integrated pest management practices as per situation. The maps will be prepared digitally and uploaded (using ARC-IMS and ARC-SDE) once in a week at main station. In the interactive window, farmers or pest managers and students/ decision makers/policy makers will be able to input their data on current pest population, required weather parameters, crop phenology and natural enemy count. The GDD/HTU/PTU CALCULATOR, the software program will calculate and generate a report on pest situation for next week (forewarning) and also generate an IPM recommendation as per the situation.

13.2 Relevance of the project to the work already going on in the organisation: This work will add strength to the on going research on climate changeand rice in ANGRAU

13.3 Implementation arrangements proposed for the project (linkages and managementstructure:



13.4 Suggestions for replicability of the research outcomes:

A GDD/HTU/PTU calculator thus developed in this project will be validated and adopted (after refinement and fine tuning, if required) in all rice growing areas of AP in next phase.

13.5 Risks:

Farmers may or may not follow the IPM advice generated through GDD/HTU/PTU calculator. They may ask for plant protection inputs along with pest warning and management advice.

13.6 Suggested plan of action for utilisation of expected outputs from the project:

Information availability to farmers / pest managers:

Those with computer and internet facility:
A fully dedicated comprehensive website will be launched as an output of this project. After opening the website, the GDD/HTU/PTU calculator helps on current and future level/ situation of the above mentioned pests, and the appropriate management action to be taken to manage those insect pests. Alternately, one can go to an interactive window and generate the report.

Those having Mobile phones:
They will get SMS/ phone calls regularly regarding forewarning and management of each insect pest from an expert through the web-site administrator.

Any farmer/ pest manager:
Three KIOSKs with internet facility will be installed in few locations and will be accessible 24x7 hours.