



## **Online Progress Monitoring of Agricultural Scientists: e Initiative**

**R.C. Goyal, Alka Arora, Sudeep Marwaha, P.K. Malhotra, Rajni B. Grover and A.K.M. Samimul Alam**  
*Indian Agricultural Statistics Research Institute, New Delhi*

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### **SUMMARY**

A web based system for Half-Yearly Progress Monitoring (HYPM) of the agricultural scientists working in ICAR institutes has been developed and hosted (<http://www.hypm.iasri.res.in>) at Indian Agricultural Statistics Research Institute (IASRI), New Delhi. The system has been developed using three-tier web architecture on the ASP.NET technology platform. Authenticated secured access has been given to all concerned users; Scientists, Reporting Officers, Reviewing Officers, Nodal Officers and Research Managers involved in the monitoring process of the scientists. Nodal officer at each Institute is responsible for Institute level customization of HYPM and has the right to assign different roles for monitoring, issue password to scientific personnel and allocation of Scientists for reporting and reviewing under Reporting and Reviewing Officers of their respective institutes. Scientists have facility for online submitting their research targets and achievements under different heads of teaching, training, extension and other prioritized activities. Research Manager Personnel (RMP's) of ICAR have the flexibility to view reports at all levels, *i.e.* Institutional, Subject Matter Division (SMD) and consolidated for the entire ICAR institutes on different parameters.

*Keywords:* Agricultural Scientists, Half-Yearly Progress Monitoring, HYPM, ICAR.

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### **1. INTRODUCTION**

The system of Half-Yearly Progress Monitoring (HYPM) of Scientists in Indian Council of Agriculture Research (ICAR) facilitates monitoring and evaluation of scientist posted in ICAR institutes spread across length and breadth of the country. ICAR institutes are categorized under Subject Matter Division (SMD) for efficient monitoring of institutes working for targeted commodities/areas. Considering the fact that ICAR scientists are spread across India, potential of Information Technology was harnessed and an online information system was developed. HYPM system assists in timely updating and availability of desired information with regard to the individual scientist's targets and the achievements against the proposed targets. HYPM system provides a unified information

base for dissemination and analysis of data relating to research, teaching, training, extension and other activities performed by the scientists of all the ICAR Institutes. The system focuses on maintaining an up-to-date data base and providing answers to queries covering all important aspects related to the work performance status of ICAR institutes. The system has been so designed that it becomes useful to the individual scientist, institutions as well as to the ICAR managers. The HYPM system has modules on Data Management, mechanism to monitor the targets and achievements as proposed by scientists, Reports and Queries for SMDs, and User Management and Administration. It has been integrated with the existing two operational systems at IASRI namely PERMISnet and PIMS-ICAR for importing data related to ICAR scientists and projects information simultaneously

(Arora *et al.* 2005, Farooqi *et al.* 2011). Moreover, the processing of available data through various modules leads to considering HYPM as a decision support system for RMPs.

## 2. HYPM REQUIREMENT ANALYSIS AND PROCESS MODEL

### 2.1 Requirement Analysis

Requirement for this system has emerged from a top-down directive approach. At ICAR headquarters in the year 2003 as a part of the overall “Agricultural Research Monitoring Information System”. It was decided that six-monthly progress report of each scientist in the institutes will be asked by emails for effective monitoring of research targets and ensuring accountability. These emails reports were monitored by the DG’s office for the first half-yearly reporting period (January-June 2003). Subsequently, the respective SMD was also involved in the monitoring process. Later on with the help of National Informatics Centre (NIC) a software was developed for this purpose. It was a standalone system, with client server architecture for email based transmission of data. It was installed at all the ICAR institutes; and at all the Deputy Director General (DDG) heading the SMD’s and the Director General (DG) office at the ICAR headquarters. A provision was available in the software to

simultaneously enable assessment of the achievement of each scientist by the Director of the concerned Institute on a scale of letter grades “A” to “E” (A-Outstanding; B-Very Good; C-Good; D-Average; and E-Below Average) while posting comments on his/her progress during the preceding six months. Dr. P.L. Gautam Committee (2011) observed that its operationalization in the existing format is highly dependent for its operativeness on the software developed by NIC informatics unit. Moreover it was standalone system in which consolidated information from scientist was fed into system and then emailed to respective SMD’s for monitoring. In view of the large number of institutes and the scientists, it was difficult to evaluate comparative performance of the scientists of inter and intra SMD on the basis of email based transmission of data from the respective institutes. Hence new HYPM system is developed based on three-tier architecture of web application development. Considering the time lines for early implementation of the system and initial requirements known in advance agile model is used for HYPM system.

### 2.2 Process Model

Many software development process models are available in literature (Goswami *et al.* 2010). In general, a process model is used depending upon the nature of requirements and applications (Pressman 2005). Since

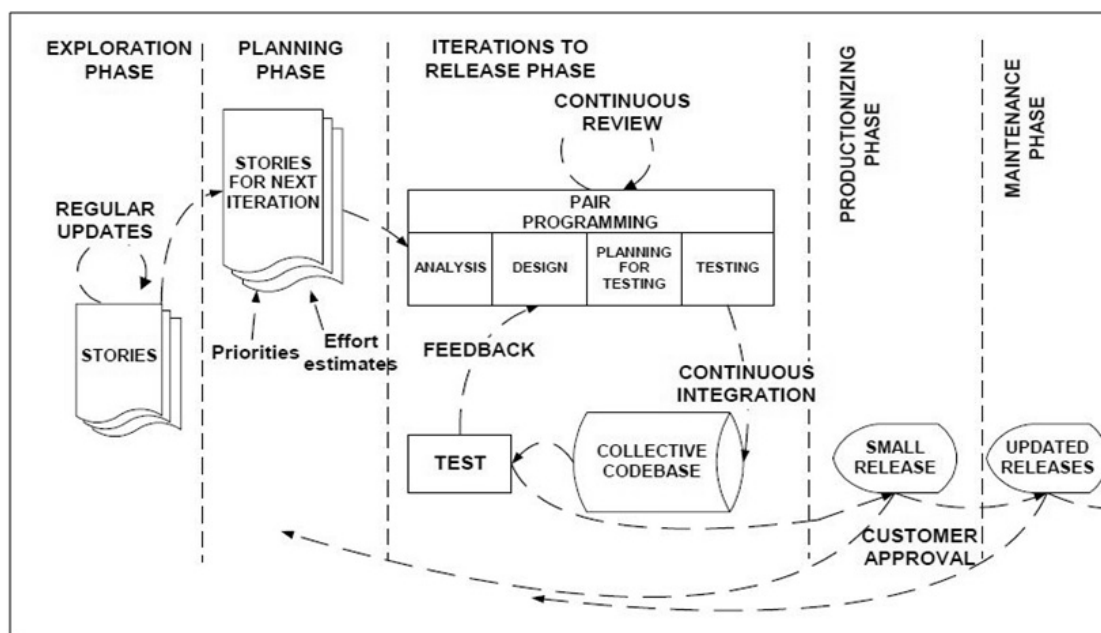


Fig. 1. Life cycle of the XP process

HYPM has dynamic requirements, and to meet this scenario, Extreme Programming (XP) model [<http://www.agile-process.org/>] has been used which is the starting point for various agile software development approaches. Agile methods are simple and speedy. Development group concentrates only on the functions needed at first hand, delivering them fast, collecting feedback and reacting to receive information (Abrahamsson *et al.* 2002). Development of HYPM is **incremental** (small portion releases, with rapid cycle), **cooperative** (expert and developers working constantly together with close communication), **straightforward** (easy to learn and modify) and **adaptive** (able to make last moment changes).

The life cycle of XP consists of five phases: Exploration, Planning, Iteration to release, Production and Maintenance as given in Fig. 1 [[http://en.wikipedia.org/wiki/Agile\\_software\\_development](http://en.wikipedia.org/wiki/Agile_software_development)].

In the exploration phase, experts have written out the different requirements that they feel to be included in the first release of HYPM. Every requirement describes a feature to be added into program. The technology and architecture possibilities for the system were explored at this stage. Standard three-tier client server architecture was finalized for the development of this web application as application requires to be accessed from any node on the Internet through a web-browser.

## 2.2 Planning Phase

This phase deals with setting the priority order for the requirements. It further deals with estimating efforts required for each requirement and schedules them. It was agreed upon that in the first release, functionality for Nodal officer module for customization of data related to respective institutions; Individual module in which scientist can fill their targets data; modules for reviewing and reporting officer to fill the comments of reviewing and reporting officers will be done. In the next release, modules for RMP's will be released with the functionality to view data at institutional level, SMD level and Council level. In another release functionality for submitting achievements against targets will be released.

## 2.3 Iterations to Release

This phase includes several iterations of the system before the first release. The schedule set in the planning

stage has been broken down into number of iterations. In first iteration, system design along with the architecture and database design has been created for whole application.

### 2.3.1 System Design

HYPM system has been designed into different modules taking into consideration the large number of different categories of users. Mainly six categories of users have been identified, which include Nodal Officers (contact person for institute); Reporting Officers; Reviewing Officers; Administrator; RMP (Assistant Deputy Director General (ADG), Deputy Director General (DDG), Director General (DG)); Individual user (ICAR Scientist). Different access rights have been provided to different class of users. Figure 2 presents different class of HYPM users.

HYPM system is based on client server three-tier architecture (Arora *et al.* 2008, Marwaha *et al.* 2013). System is developed using Dot NET technology. ASP.NET programming framework with C# programming language has been used for designing of user interface and coding of the business logics in the system (Esposito 2005, Macdonald 2002, Liberty and Xie 2007).

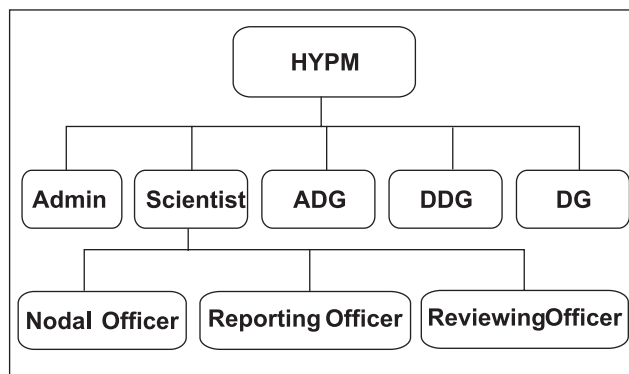


Fig. 2. Different users in HYPM

### 2.3.2 Database Design

HYPM contains data on employee parameters, research projects and parameters of teaching, training and other prioritised activities arranged in different tables. SQL Server 2008 has been used for database management. A primary key in each table is identified for uniquely defining the record. Similarly, the foreign keys are identified from other tables for setting relationship among different entities (Date *et al.* 2006). Some of the tables are master tables, which are meant

for providing the real world values to fields in different tables while building the queries and presenting the reports. Entity Relationship (ER) diagrams of HYPM has been presented in Fig. 3. ER diagram shows the

relation between different tables (Elmasri and Navathe 1994, Sharma *et al.* 2006, Pal *et al.* 2009). Table 1 presents the general description of the tables used in HYPM.

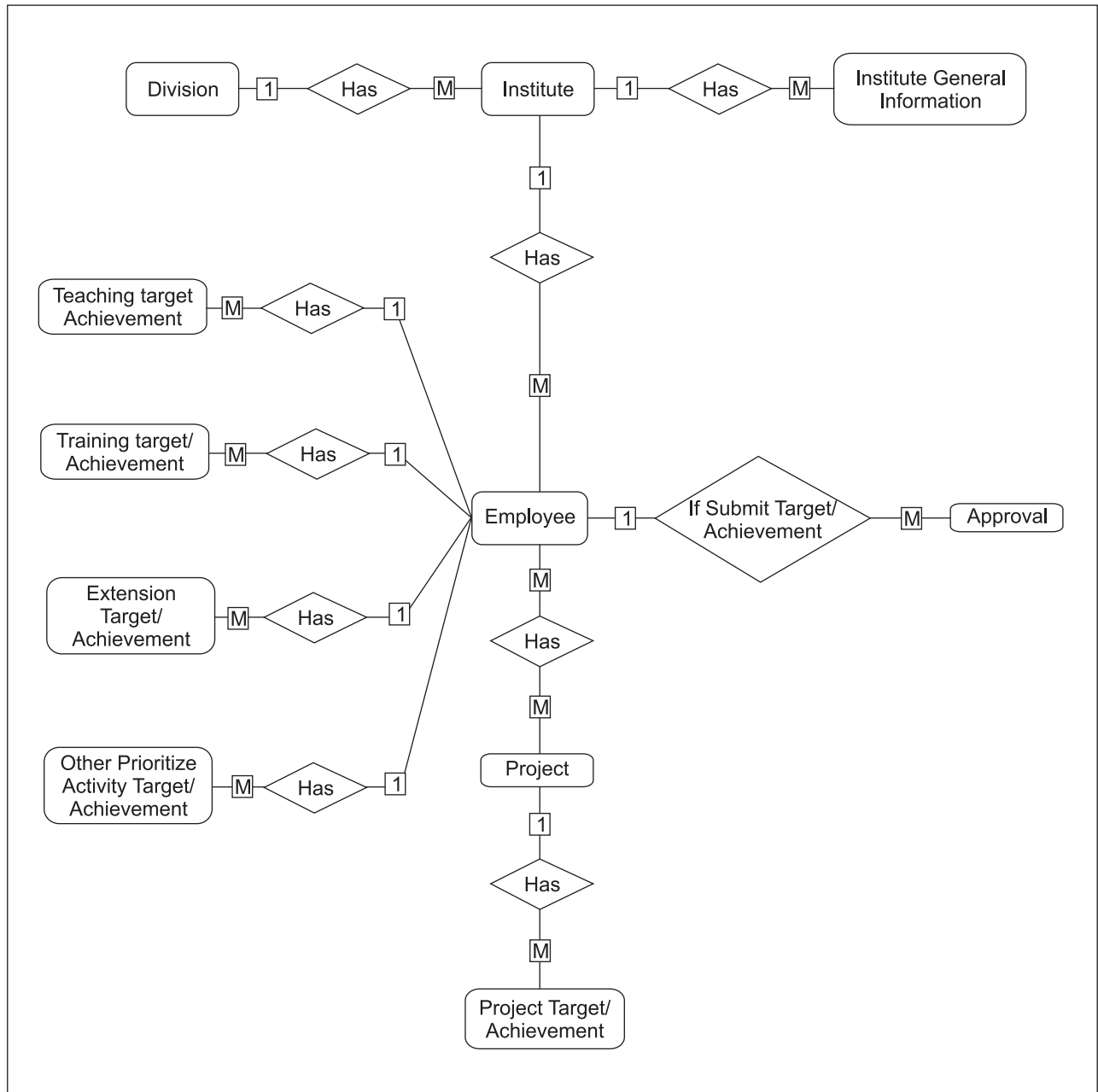


Fig. 3. Entity Relationship Diagram

**Table 1.** Description of tables in database of HYPM

Table Name	Description
Division	Name of Subject Matter Division in ICAR
Institute	Contains information (like name, address, type etc.) about all institutes under ICAR
Institute General Information	Period and year wise general information about the institute
Employee	Contains information (like name, address, Email, level) about all scientists working under ICAR system
Project	Information about project details of each scientists
Project Target/Achievement	Target and achievement of each project for each period and year
Teaching Target/Achievement	Contains target and achievement in teaching for every period and year
Training Target/Achievement	Contains training target and achievement of scientist for every period and year
Extension Target/Achievement	Contains target and achievement regarding extension activities for every period and year
Other prioritize activity Target/Achievement	Contains target and achievement in other prioritized activity for every period and year
Approval	Approval information given by reporting or reviewing officer to submitted target and achievement of each scientist for every period and year

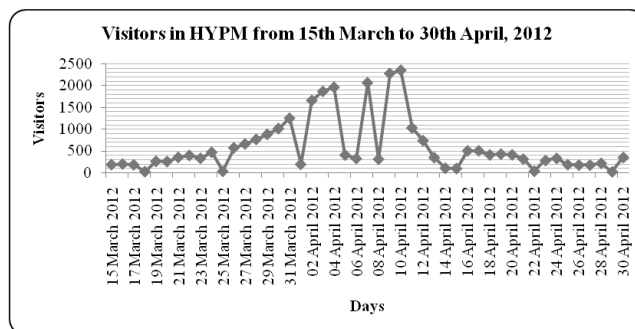
In each iteration expert decided about the requirements to be implemented. The functional tests created by the expert have been run for all iterations. After completion of testing of modules, they are integrated into the system.

#### 2.4 Production Phase

Some extra testing and checking of the performance of the system was done before releasing the software to the user community. For effective implementation of the system, managers at Council level had taken the responsibility and Nodal officers

from each of the ICAR institutes were identified and given the responsibility for assigning roles and password to scientific personnel of their institution. Initially for  $\beta$  - testing, a workshop was organised at IASRI, New Delhi and changes suggested were incorporated in the first release. After that, implementation and post implementation workshops were organised to train nodal officers of all the ICAR institutions. Suggestions from different workshops were incorporated in the next release of the system.

HYPM system was implemented in March 2012 and was open for filling the Targets information till April 2012. Scientist filled in the information related to targets only. Later on in the next release in September 2012, functionality for filling the Achievements against previously filled targets and targets for next six months was implemented. Visitor profile of HYPM users in the initial stage through Google Analytic is given here in Figure 4. Maximum users visited the system during the period 1st to 15th April, 2012. Total numbers of visits were around 27,000 out of which 8,299 were unique visitors during March-April 2012.

**Fig. 4.** Visitor in HYPM

#### 2.5 Maintenance Phase

After the release is productionized for users, the XP project kept the system in the production running phase and simultaneously also producing new iterations. In the last iteration functionality for manager level (DG, DDG) was made. This part was released in December, 2012. When the iterations were going on, maintenance phase required an effort also for users support tasks. Email based and telephonic support was provided to users for data management. User manuals and presentation was loaded into system for easy reference. In the maintenance phase, on line support is provided to users in case of problems faced by them.

System is opened twice in a financial year by end of March to mid-April and then end of September to



mid of October to fill the six monthly targets and achievements. System has stabilized over a period of approximately two years starting from April 2012 to February 2014. During this period a total of 1, 38,942 visits were made in the system out of which 36,857 are unique visitors in HYPM website. Fig. 5 shows the monthly visit during this period through Google analytic. Pattern shows that users have adapted the system and now they are coming during the assigned period. There are less calls for online support.

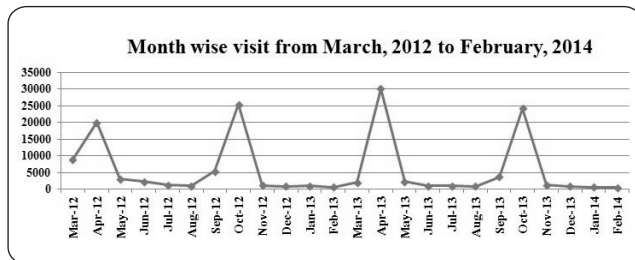


Fig. 5. Visitor in HYPM during 2012 to 2014

### 3. FUNCTIONALITY OF HYPM

Home page of the system is depicted in Fig. 6. HYPM has been designed to cater different types of users [Fig. 2] and different access rights have been defined for all the users. After authentication users have been provided different features depending upon their category [Fig. 7]. For Admin, Scientist, Nodal Officer, Reporting and Reviewing officer categories, there is a provision for data management and reports depending upon the requirements. At the level of RMP's, option for reviewing the information is given in the form of reports.

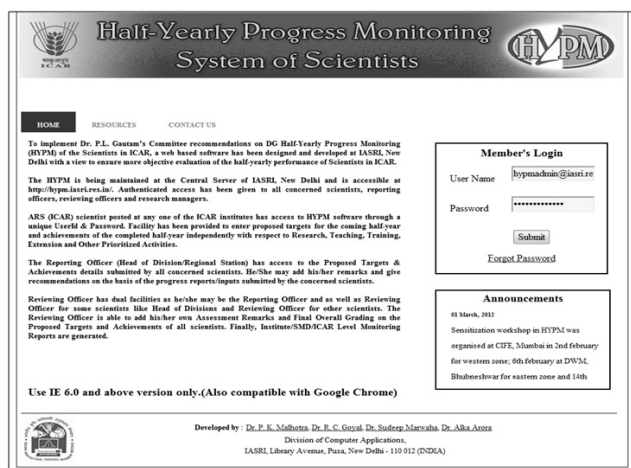


Fig. 6. Home Page of HYPM

Features available with different users are summarised here.

- **Scientist:** Scientist posted at any one of the ICAR institutes has access to HYPM software through a unique User Id & Password. Facility has been provided to enter proposed targets for the coming half-year and achievements of the completed half-year with respect to Research, Teaching, Training, Extension and Other Prioritized Activities.
- **Nodal Officer:** User has the responsibility for data management for their respective institution. User has to issue password to scientist, allocation of scientist under Reporting and Reviewing Officer and filling of general information for the institute. The Nodal Officer as a scientist also, would be able to Enter/Verify & Submit his/her own Proposed Targets and Achievements for half-yearly progress monitoring to the concerned Reporting Officer. Data management option for nodal officer is depicted in Figure7.
- **Reporting Officer:** Head of Division/Regional Station has access to the Proposed Targets & Achievements details submitted by all concerned scientists. User can add remarks and give recommendations on the basis of the progress reports/ inputs submitted by the concerned scientists.
- **Reviewing Officer:** User has the responsibility to add their own Assessment Remarks and Final Overall Grading on the Proposed Targets and Achievements of all scientists. At times, this user has to play dual role of Reporting as well as Reviewing Officer. User may be reporting officer for some scientists like Head of Divisions and Reviewing Officer for other scientists.
- **DDG and ADG:** Access to Institute Level Monitoring Reports has been provided to the concerned DDGs of respective subject matter division (SMD).
- **DG:** Access to Institute Level Monitoring Reports of all institutes of ICAR has been provided to DG, ICAR.
- **Admin:** Administrator has the sole power of entering/updating master forms.

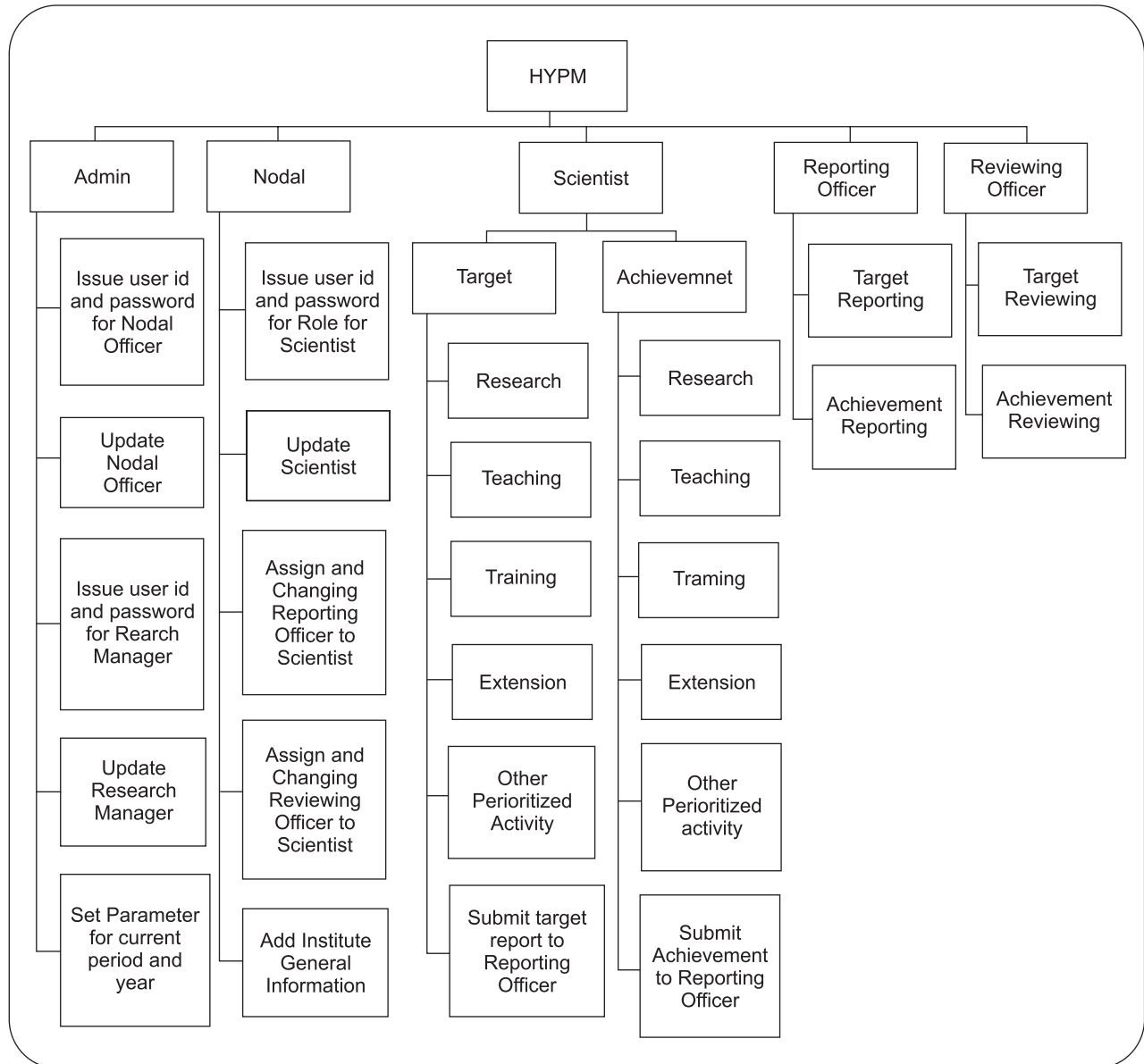


Fig.7. Different Activities of Users in HYPM

Process flow in HYPM is depicted with the data flow diagram as shown in Fig. 8. In HYPM, Scientist fills the targets/achievements for different activities. Once Scientist fills the information and submits to higher level then editing rights are restricted and user can't do any updating. These targets/achievements are submitted to Reporting officer who in turn fills the comments after verifying the input submitted by the Scientist. In case Reporting officer is not satisfied with the filled in information then he/she has the right to reject the same and intimation is sent to Scientist about

rejection by auto generated mail. After approval from Reporting officer, comments of Reporting officer along with filled in information by Scientist is then submitted to Reviewing Officer for their comments. Once comments of Reviewing Officers are given then information is finally submitted for viewing at the Managers level (DG, DDG). Reviewing officer has the right to reject the comments filled by Reporting Officer or information filled by the Scientist, then intimation will be automatically sent at respective levels informing about the same.

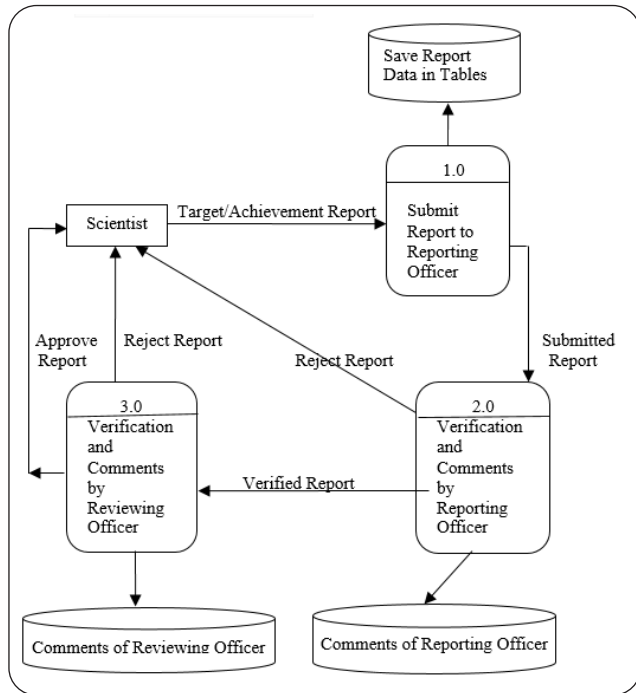


Fig. 8. Data Flow Diagram in HYPM

### 3.1 Management Reports

This module provides variety of options for generating management reports for different institutes. Most of the management reports are displayed in ADG/DDG/DG level.

Some major reports of HYPM are summarized here:

1. **Target Submission-Status Report:** Report on target submission status of scientists in various institutes, it is shown to nodal officer for his institute only and ADG/DDG for those institute belonging to their respective SMD. DG can see status of any Institute.
2. **Achievement of the Institute:** This report indicates number of scientist (within an institute) who has attained some specific achievement grade. Institute level report provides information about number of scientists (institute wise) for a period and year on parameters such as

- (a) Scientist Registered with HYPM
- (b) Scientist Submitted Target

- (c) Scientist Submitted Achievement
  - (d) Reporting Officer Commented
  - (e) Reviewing Officer Reviewed
3. Institute/PDs/NBs/NRCs wise Target/Achievement entry status and SMD wise Target/ Achievement Entry Status reports are available at DG level. (Fig. 9).
  4. Reviewing officer can see institute general information report. Report is visible at ADG/DDG/DG level (Fig. 10).
  5. Some reports at SMD and Council level such as
    - (a) Manpower Status of the Institutes
    - (b) Research Project Status at Institutes
    - (c) Salient Research Achievements of Institutes

SNo.	SMD	Scientist Strength	Scientist Registered with HYPM	Scientist Submitted Target	Reporting Officer Commented	Reviewing Officer Reviewed
1	Agricultural Education	45	45	44	42	42
2	Agricultural Engineering	252	248	232	227	221
3	Animal Sciences	820	766	581	544	520
4	Crop Sciences	1598	1473	1345	1215	915
5	Extension	18	18	16	16	16
6	Fisheries	411	452	341	264	215
7	Horticulture	722	657	572	556	542
8	Natural Resource Management	779	681	633	628	617
	Total	4745	4340	3764	3492	3088

Fig. 9. SMD Wise Target Entry Status

Institute Name	National Institute of Research on Jute and Allied Fibre Technology, Kolkata, West Bengal
Period	II (From October to March)
Year	2011-12
Target as on	01/10/2011
Achievements as on	31/03/2012

<b>Number of Scientists</b>	Total reported upon	19
	In position	22
	At institute headquarter	22
	At regional station	0
	On leave/ study/ training	2
	Cadre strength	45
<b>Number of Reporting Unit</b>	Divisions	4
	Regional station	0
<b>Number of Research Projects (RP)</b>	Total reported upon	23
	Institute project	16
	Externally funded project	7
	Post graduate students' research	0
<b>Number of other Prioritized Activities (PA)</b>	O & M Support	0
	Technical assistance	2
	Policy support	1
	IP management support	4
	Liaison with clients-farmer participatory activities	2
	Liaison with industry clients	0

Fig. 10. Institute General Information Report



#### 4. CONCLUSION

The HYPM system has been designed, developed and implemented for online submission of targets and achievements by the scientists and it's monitoring by the managers. The users have online access to HYPM through a unique User Id and Password. Scientists are able to enter/edit their proposed Targets and Achievements for half-yearly progress monitoring to the concerned Reporting Officer. Reporting and Reviewing Officers can online accept/reject the information filled by the Scientist. Moreover Policy makers are able to handle the challenging task of monitoring the progress of individual Scientist/Institutions and all the institution in their SMD/Council. Google Analytics showed encouraging results when system was implemented for submitting and monitoring the Targets. Constant support is provided to users through planned workshops and emails. Continuous updating and addition of new reports and modules in the system will go a long way in providing improved decision support to RMP's and Nodal Officers of the ICAR.

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