

## **Sharing of knowledge on rice technology through publications**

(Perkongsian maklumat teknologi padi melalui penerbitan)

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Keywords: rice research, publications, journals, bulletins, research disciplines

### **Abstract**

MARDI has been actively performing research and development (R&D) on rice since its establishment in 1969. The technologies generated are transferred for the benefit of farmers and public in general. One of the most common approaches to transfer technology is through publication. This study aimed to evaluate the relationship between R&D activities and publications on rice by MARDI researchers. Data were collected from all publications published by MARDI between 1973 and 2010 (38 years). This study found that 79 technologies related to rice were generated, with an average of two technologies per year, of which most of them are on varietal development. During the same period, a total of 374 articles on rice were published in MARDI journals, bulletins, reports, books, manuals and magazines. On average, 10 articles were published every year, and most of them are in agronomy discipline. Most of articles were published in bulletins (39%) and journals (36%). In conclusion, there is a strong relationship between R&D activities and publications on rice. New technologies and knowledge on paddy were well transferred and shared between researchers and the target audience.

### **Introduction**

The Malaysian Agricultural Research and Development Institute (MARDI) was established in 1969, through the Act of Parliament, to spearhead the agricultural sector in Malaysia. The principal function of MARDI at that time was to conduct scientific, technical, economic and sociological research in Malaysia with respect to the production, utilisation and processing of all crops (except rubber), livestock and fresh water fisheries (MARDI 1970). During the inauguration of MARDI on 28 October 1969, the Prime Minister of Malaysia, YAB Tun Abd Razak called on MARDI to tackle six problem areas. One of which was to increase the nation's rice production in order to achieve self-sufficiency (MARDI 1990).

Since its establishment, MARDI has been mandated to carry out R&D on rice to generate new technologies that can enhance the rice industry in Malaysia. The research focuses on varietal development for high yield and quality rice, development of cost-effective, sustainable and environmental friendly production system with emphasis on optimum input utilisation, management of key pest and diseases, and development of efficient post-harvest handling and product development technologies.

The research and development of rice are mainly carried out at MARDI Seberang Perai in Pulau Pinang. The main output of R&D is new technology and new knowledge. Every year, researchers generated new technologies and new knowledge on rice, that include new

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varieties of paddy, production system, farm management, pest and diseases management and post harvest handling. These technologies are screened and evaluated by the management of MARDI before they are transferred to farmers.

Technology transfer is an important aspect of research and development in government research institutions. It is the focus of all government research institutions to ensure the outcomes of their research and development reach market acceptance. Technology transfer is the process by which technology developed by government research institution is transformed into new products or system, information and knowledge. New technology is useless until it is used and benefits the public. MARDI uses many approaches to transfer its technology and new knowledge to farmers, through extension agencies such as the Department of Agriculture and Farmers Organisation Authority, seminars, conferences and publications.

Besides generating new technologies, publication is the other major output of scientific research. Researchers publish and disseminate their work in many different ways: through formal publications and web-based tools. The choices they make are underpinned by a number of interrelated motives beyond the simple desire to pass in their findings to those who may be interested in them. These motivations include the desire not only to maximise dissemination to a target audience, but to register their claim to the work they have done, and to gain peer esteem and the rewards that may flow from them (JISC 2009).

However, differential spending in research among nations is unlikely to account for all variations in publications output across the world. Some nations invest a great deal on research and yet their level of productivity lags behind other nations that spend less (Tompkins et al. 2001). Research spending and English proficiency were strongly associated with publication output in the highest ranked general medical

journals. For instance, a 1% increment in research funding was associated with a 2.17 unit increase in publications rate of these journals (Jonathan et al. 2004).

Promotion, grant applications, and finding new jobs all depends on having a strong publication record. This has long been described as 'Publish or perish', because if you do not publish, you perish – either you do not advance in your job, you cannot find a job, or you do not keep your job (Watts 2012).

The increasing importance of publications and citations as measures of research productivity is generating mounting interest in the determinants of individual and organisational research output and impact. The ability to estimate the expected number of publications and citations of researchers can be of critical importance to administrators of universities or research laboratories, both public and private (Claudia and Francisco 2007).

The results of research are usually presented in various publications. The most common publications types are monograph, chapter in a book, original research paper published in a scientific journal, publication in a professional journal, conference paper and research report.

A published article is the primary means whereby new work is communicated, priority is established, and academic promotion is determined (Rennie et al. 1997). It is commonly accepted that the results of any research are disseminated worldwide and made available to the scientific community by way of publishing journals, bulletins and others (Sancho 1990).

The objective of this study was to identify the relationship between research and development and the trend in publications on rice published by MARDI scientists during 1973 – 2010. The research disciplines involved in the publications and technologies were also analysed.

### The evolution of rice publication in MARDI

MARDI has started publishing research articles in several agricultural commodities since 1971. In the first year, out of the 16 articles published, nine articles were related to rice research (Table 1), demonstrating the fact that MARDI researchers had been actively publishing early articles on rice.

In view of the increasing quantity of research information that was expected in subsequent years, the Institute decided to produce its own scientific journal, initially named 'MARDI Journal'. The MARDI's Scientific Council and the Governing Board gave their approval in 1971 and the Journal was supposed to make its appearance in 1972. Nevertheless, MARDI first journal was published in 1973 and was named *MARDI Research Bulletin*. In 1989, the name was changed to *MARDI Research Journal*, and later to *Journal of Tropical Agriculture and Food Science* in 1997 (Rosiah 2011). The journal is published biannually and every issue consists of 15 – 20 articles on various commodities in various disciplines.

Scholarly journal is a form of formal communication and often used as the measurement of research credibility in research institutes, universities and

professional associations. Journal is published to disseminate research findings, develop research discipline, upgrade the image of the publisher, broaden the influence, as an academic reference and as platform for career promotion for the researchers.

Other than journal, MARDI also publishes bulletins. The similarity between bulletins and journals is that both publications go through peer review and classified as refereed publications. In research institutes and universities, refereed articles are considered compulsory for all researchers. The difference between the two publications is that the contents of bulletins are semi technical and some are more of package technologies, that is technologies ready to be taken up by the intended groups.

The first of MARDI bulletin was given the name *Teknologi Pertanian* (1980 – 1984) and eight issues were published in this biannual publication. The second bulletin was commodity technology bulletins (CTB) (1985 – 1997). The bulletins were categorised into nine titles according to the main research commodities in MARDI at that time. Due to the inconsistency in paper submission in some of the titles, the CTB publications were discontinued. The bulletins were revived in 2005 with

Table 1. The earliest articles on rice published by MARDI in 1971

Title of articles	Authors
Two promising hybrid varieties of glutinous padi	Sivanaser, M. and Hadzim, K.
Fertiliser trials with padi Bahagia in the Muda Project Area	Samy, J.S., Leong, S.Y. and Geissenhainer, R.H.
Control of rice-field rats in West Malaysia	Ralph, A. Otto
A preliminary study of the control of paddy field crabs with insecticides	Lim, G.S., Samy, J. and Phang, C.C.
On prospects of self-sufficiency in rice for West Malaysia	Lai, K.C.
Rice policy in Malaysia	Abdul Rahman, Y. and Ani, A.
A proposed model for planning of pricing and import policy for rice based on income and welfare considerations	Lai, K.C.
Empirical cost functions for rice farms in Malaysia	Shaaban, S.
Uniformity trials on rice varieties Ria and Bahagia at Bumbong Lima Rice Research Station	Lee, C.S.

Source: MARDI (1971)

three new titles namely *Buletin Teknologi Tanaman*, *Teknologi Makanan* and *Teknologi Ternakan*. However, these bulletins were also discontinued and the last publications was in 2011. To replace these bulletins, the management decided to publish a new biannual bulletin named *Buletin Teknologi MARDI* in December 2012.

After more than 40 years in existence, MARDI has published numerous types of publication which include journal, bulletins, MARDI reports, scholarly books, general books and magazines covering on research of agricultural commodities including rice. The several types of publications are produced to meet the need of the target audience e.g. scientists, farmers, extension agents, share holders and the public.

### **Methodology**

Data on publications of rice research were screened manually from MARDI publications printed in 1973 until 2010. The main publication was the journals (*MARDI Research Journal*, *MARDI Research Bulletin* and *Journal of Tropical Agriculture and Food Science*). A total of 1,227 articles were screened from these three journals.

As a research institute, MARDI also publishes bulletins other than journals. The bulletins comprised *Teknologi Pertanian*, nine titles of commodity technology bulletins, *Buletin Teknologi Tanaman*, *Teknologi Makanan*, *Teknologi Ternakan* and *Economic and Technology Management Review*. All articles published in these bulletins were also screened.

Besides MARDI's journal and bulletins, all other MARDI publications published in 1973 – 2010 were also screened. These include 212 titles of MARDI reports, 113 titles of books, 55 titles of technology manuals and 33 issues of Agromedia magazines.

As for the list of technologies generated, data were screened from four books published by MARDI [*MARDI Gemilang Empat Dekad Penuh Tekad (1969 – 2009)*, *MARDI Three Decades of*

*Achievement in Research and Development (1973 – 2008)*, *MARDI Three Decades of Achievement in Research and Development – Supplement (1973 – 2010)*, and *Pencapaian Penyelidikan dan Pembangunan (R&D) dalam tiga dekad (1973 – 2010)*] (MARDI 2005, 2008, 2010a, b, 2013).

The four books reported differently on the number of technologies generated. On verifying the information (number of rice varieties released by MARDI), it was found that some information was not reported in the books. The book reported the highest number of technologies was chosen and the missing information was added.

This study focused on articles published by MARDI only. The study, however, did not include articles by MARDI rice researches published in external journal both locally and overseas, including papers in proceedings of rice conferences that were jointly published and organised by MARDI with other bodies. There is no available internal record that can effectively enable tracking all the articles published externally.

The information on publications and technologies related to rice was further categorised into main research disciplines namely agronomy, breeding, pests and diseases, weeds, mechanisation and automation, food technology, economy and others.

### **Results and discussion**

As a leading agriculture research institute, MARDI generated 79 technologies on rice during its 38 years of establishment (1973 to 2010). As a result, MARDI published internally 374 articles on rice.

The 79 rice technologies generated in 1973 – 2010 comprised 15% of the total technologies (527) generated by MARDI (MARDI 2010a, b, 2013). However, most of the rice technologies (38%) were generated in 2006 – 2010 (10<sup>th</sup> Malaysia Plan). The reason could be due to the higher number of research funds (IRPA, ScienceFund, TechnoFund, and private sectors) being awarded to MARDI. This study also found

that a lot of information on rice research was published in 1986 – 1990 and 1991 – 1995 (Figure 1). Most of these articles (106) are found in the 12 issues of *Teknologi Padi* bulletin published from 1985 – 1996.

Parallel with the increased in number of research and development, the rice articles published by MARDI also showed a significant increase trend in 2006 – 2010. This finding supports the previous researches on the relationship between research and development activities and trend of publication. For example, the Singapore-based Elsevier Company reported the results of their study on the number of publications of all countries in the world, in 2010. The data showed a significant increase rate of publications resulting from research activities. For a period of five years (2006 – 2010), the average rate of increase in the number of publications in Malaysia stood at 28.42% and was the highest increase rate in the world (Mohamed Khaled 2011).

Figure 2 shows that the highest number of publications (22/year) were produced in

1989 and 1990. The articles were published in *Buletin Teknologi Padi* (11), *MARDI Research Journal* (11) in 1989, and for 1990, *Buletin Teknologi Padi* (2), *MARDI Research Journals* (11) and *MARDI report* (4). All these publications are categorised under scholarly publications and all articles were peer-reviewed before published. This is a very important criterion for research publications.

MARDI publications also showed decreasing trend in 1993 – 2003, where in 2003 only one rice article was published. An analysis of 16,891 publications published by Indian scientists during 1993 – 2002 and indexed by Science Citations Index Expanded (Web of Science) indicates that the publications output in the agricultural sciences are on the decline since 1998 (Garg et al. 2006).

**Rice publications and technologies**

Publication activities in MARDI include documentation and dissemination of research results and findings to targeted groups. As a research institute, most articles are

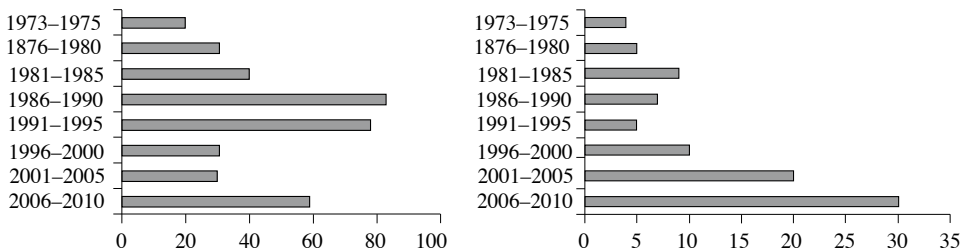


Figure 1. Publications on rice (left) and rice technologies generated (right) throughout 1973 – 2010

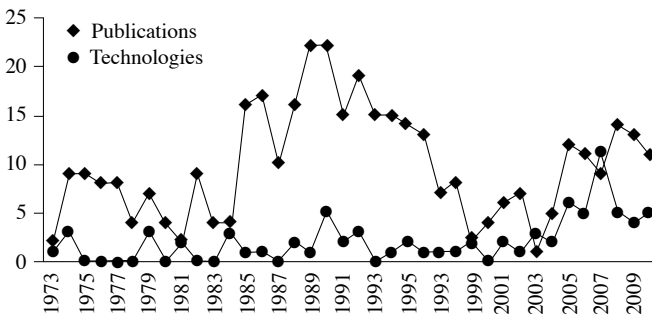


Figure 2. Trends of publications and technologies on rice produced by MARDI in 1973 – 2010

published in journals and bulletins. During 1973 – 2010, rice researchers sent their articles mostly to journals and bulletins (36% and 39% respectively), followed by MARDI report (14%), Agromedia magazine (6%) and books/manuals (4%) (Figure 3 and Plate 1) (Rosiah 2012a, b).

Journal articles contain detailed descriptions of scientific studies so that other scientist can evaluate the investigations and their results. Scientists (usually a group of

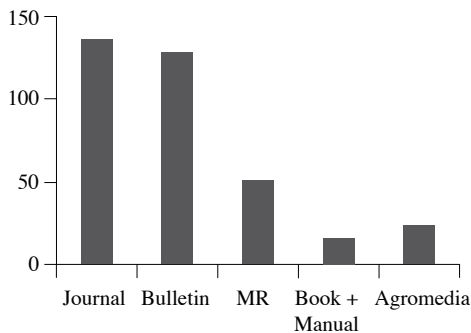


Figure 3. The number of articles related to rice published in various forms of MARDI publications

collaborators) describe a study and report any details one might need to evaluate that study – background information, data, statistical results, graphs, maps, explanations of how the study was performed and how the researchers drew their conclusions, etc. (Undsci. 2014).

Publication in a peer-reviewed journal remains the most important way of disseminating a complete set of research results. The importance of publication accounts for the fact that the first to publish a view or finding—not the first to discover it—tends to get most of the credit for the discovery.

An analytical study on articles published in MARDI’s journal (*Journal of Tropical Agriculture and Food Science*) from 1997 to 2008 reported that articles on rice showed an increasing trend every year, after articles on fruits (Rosiah 2011). This was a positive trend for rice commodity because the articles on fruits were written on 20 types of fruits while articles on herbs comprised of 13 types of herbs (Figure 4).



Plate 1. Information on rice technologies is published in various MARDI publications

However, journal articles on rice comprised of 11% (135 articles) of all the journal articles published in MARDI's journals during that period. A total of 47 articles published in *MARDI Research Bulletin* (1973 – 1986), 38 in *MARDI Research Journal* (1988 – 1996) and 50 in *Journal of Tropical Agriculture and Food Science* (1997 – 2010). Generally, journals distribute scientific information to researchers all around the world so that they can keep current in their fields and evaluate the work of their peers (Undsci. 2014).

In the first bulletin published by MARDI, *Teknologi Pertanian* bulletin (1981 – 1984), only six articles were on rice. The *Teknologi Padi* bulletin published in 1985 – 1996 contained 106 articles on rice covering various disciplines. For other bulletin publications, 34 articles related to rice were also found in *Teknologi Tanaman*, *Teknologi Makanan*, *Teknologi Kejuruteraan Pertanian* and *Economic Technology and Management Review*. The number of articles in bulletins is higher than that in journals (Figure 5). The graph shows a sharp increase of bulletin publications in 1986 – 1995 and this was due to the *Teknologi Padi* bulletin which was published annually for 12 years with 8 – 10 articles per year.

MARDI Report is also a peer-reviewed publication. Of the total 214 titles published in MARDI Report until 2010, 52 titles (24%) were on rice research. The first article on rice (*Assessment for some rice diseases*) was printed in 1973 and published under MARDI Report No. 4. The last report printed in 2010 was MARDI Report No. 212 (*Kajian kehilangan padi semasa penuaian oleh jentuai di jelang padi Malaysia*).

The technology manuals were published as guidebooks for farmers and entrepreneurs. Throughout the 38 year period (1973 – 2010), 54 titles had been published and six of them were on rice. The manuals were first published in 2002 and the first four articles were on rice. The first article entitled *Pengeluaran padi berhasil*

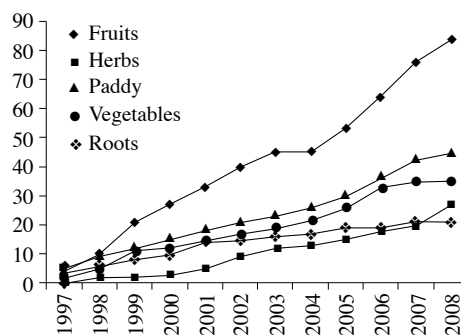


Figure 4. Frequency of articles published in JTAFS according to five main crops

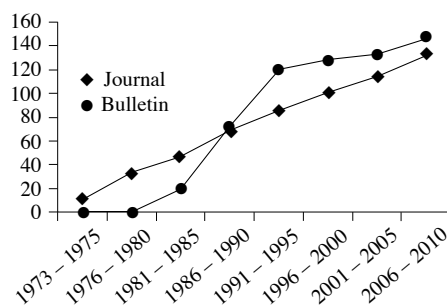


Figure 5. The frequency of rice articles published in journals and bulletins (1973 – 2010)

tinggi and the last article published in 2010 was *Pengurusan siput gondang emas*.

MARDI also publishes books categorised as scholarly books and general books. Throughout the study period, 10 books were published on rice. The first book was published in 1978 entitled *The rice field rat* and the last one was *Weedy rice-biology, ecology and management* published in 2008.

To disseminate information on technology to general audience, MARDI has been publishing Agromedia magazine since 1997. This triennial magazine covers news related to agriculture and is of competitive value with other agriculture magazine in the market. A total of 25 articles on rice were published in this magazine. The first article on rice, *Padi baru MR 185*, was published in the first issue of the magazine. Generally, the articles published in Agromedia are targeted for general public. The articles are written in popular writing style.

Results show that MARDI scientists prefer to publish in journals and bulletins compared to books and magazines. Researchers in the sciences are more likely to see publications in a learned journal as a ‘natural’ means of communication with their desired audience, while their colleagues in engineering, humanities and the social sciences are more likely to see it as meeting essentially requirements for research assessment and career advancement (JISC 2009).

In deciding when, where and how to communicate their work, researchers may have to make choices between speedy dissemination to a desired audience, and less speedy publication in a high-status journal. Such choices are made more complex because researchers know that publications serve not only as means of communication. They can be monitored or measured as indicators of quality or impact (in the academic world and more widely) (JISC 2009).

In a study done on Mexican researchers, it was found that a record of past publications showed fewer future papers but with higher impact. This can mean that, as researchers progress in their career, they tend to be less concerned with quantity but more with impact, devoting more effort to a smaller number of higher impact papers (Claudia and Francisco 2007). A journal impact factor is a measure of how often its papers are cited, and is used as a proxy for quality. To some scientists, however, this criterion is not a fair way to assess the merit or productivity of a researcher.

### ***Research disciplines in rice technologies and publications***

The research and development activities on rice are focused on three thrust areas; development of new varieties with emphasis on quality, high yield and pest resistance; development of cost-effective, sustainable and environment-friendly production systems with emphasis on optimum input utilisation and integrated

pest management; and development of efficient post harvest handling and primary processing technologies.

It is also known that research is done across disciplines. Before a new rice variety is developed, research is done in almost all aspects that cover many disciplines such as breeding, agronomy, mechanisation, pests and diseases and also economy. A research project has to be cross-discipline to ensure that the research is comprehensive and addresses all aspects. This leads to research excellence and becomes catalyst for innovations resulting in technology and knowledge breakthrough that will result in commercialisation of the research product. A scientist relies on communication within a diverse scientific community. Science often investigates problems that require collaboration from those on many different disciplines (Undsci. 2014).

In rice research, many disciplines are involved before a technology is generated. The breakdown of rice articles in all publications according to disciplines was 19% in agronomy, 13% articles in mechanisation and breeding respectively and 12% articles in pest. Agronomy discipline was top on the list due to the wide areas covered by the discipline that include soil and water management, fertiliser requirement, crop production and others. The study also found that articles on agronomy were at the top of the list in

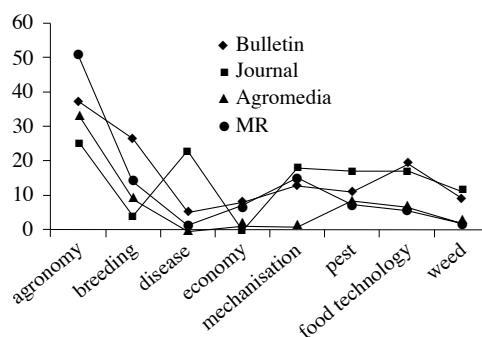


Figure 6. Number of articles on rice categorised according to fields of research and main types of publications



the four main publications namely journal, bulletins, MARDI reports and MARDI magazine, Agromedia (*Figure 6*).

The earliest technology launched in 1973 was the rice variety Jaya. Breeding discipline made out 42% of the technologies generated as 33 new varieties were developed in that period (1973 – 2010). Technologies in agronomy and mechanisation were about of the same number that is 15% and 14% respectively, followed by technologies in food technology and pest and diseases which comprised of 9% and 7% respectively.

When the charts of publications and technologies on rice were compared, they show that agronomy, breeding, mechanisation and food technology disciplines were very active in publications and technologies generated (*Figure 7*). Breeding was the highest due to the number of new varieties developed. MARDI has developed 37 rice varieties since 1971 and to date, seven of the varieties are still being planted over a large acreage of rice granary in the country.

***The relationship between research and publications***

MARDI is active in doing research covering disciplines in agricultural commodities. A total of 1,162 R&D MARDI projects were completed from 2001 to 2010 (*Table 2*).

The total number of rice projects, however, could not be determined. With 1,162 projects completed, many publications should have been produced. The writing of research articles, especially journal articles, may not necessarily wait until the project is completed. Additionally, from one completed project, a few articles can be produced to be published in different forms of publications.

In order for science to progress, researchers must share their findings through scientific publications. Scientific or scholarly communication is an essential part of the

Table 2. Completed MARDI R&D projects (2001 – 2010)

Year	IRPA/ government funding	Non government funding	Total
2001	143	22	165
2002	21	28	49
2003	61	30	91
2004	63	56	119
2005	42	48	90
2006	34	35	69
2007	70	77	147
2008	51	85	136
2009	85	40	125
2010	69	102	171
Total	639	523	1162

Source: MARDI (2001 – 2011)

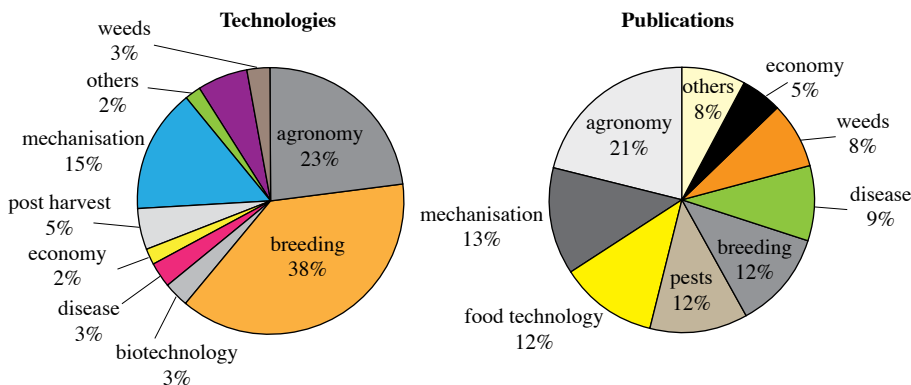


Figure 7. The comparison of publications and technologies generated according to the research disciplines

scientific research process. Not only do scientists want to disseminate the result of their work to the public and their peers but they also need to ensure that their research findings are original (Shelton 2005).

In the US, its government investment in R&D was much more significant than that by industry. Budget of individual US research agencies were correlated with overall paper production with papers in their disciplines (Shelton 2008). But in India, Arora et al. (1996) examined the extent of research undertaken in Indian medical colleges and concluded that majority of the 88 Indian medical colleges receiving research grants from Indian Council Medical Research did not produce any research paper in 1991.

According to Clapham (2005), the problem not producing publications lies with scientists who work for years but rarely submit their results to a refereed journal. There are many reasons why this failure to publish a scientific crime. The most obvious is that the information is lost to the world. Without publications, the scientist's work will have been largely wasted. Scientists do need to publish at least the most significant parts of their work.

Different types of publications are of different value when research and publications activities are assessed. In MARDI, different publications have their own points that will be used when assessing researchers for promotion. Consequently, publication track records are often used to determine whether or not researchers get hired, promoted or funded for their future research (Rubin 2014). Within universities, the assessment of research and publications activities are important to obtain an academic title such as Professor and every university has its own set of criteria for the awarding of academic titles (Anon. 2014).

Researchers are now told that they must not only publish their research but also get their publications acknowledged by other researchers and society at large. In practice, this means that researchers need to get their

publications (a) cited in the work of other researchers and (b) discussed in traditional and online media. To help achieve a greater scholarly and public impact, researchers must promote and advertise their work as much as possible (Rubin 2014).

In an effort to increase their scholarly impact, researchers are now advertising their work on professional social networking websites such as *Academia* and *ResearchGate*, which have over 12 million researchers signed up between them (Rubin 2014). A number of MARDI scientists have joined the *ResearchGate* website.

The quality and quantity of a researcher's publications provide a key measure of their research productivity. In addition, at the institutional level, the quality and quantity of its publications output help to determine its international reputation and the amount of funding that it receives based on national research performance reviews (Rubin 2014).

### **Conclusion and recommendation**

MARDI has been actively performing research and development in agriculture since its establishment in 1969. The success of research can be measured by the technologies generated and also the publications produced. The technologies and publications are transferred for the benefit of farmers, researchers and public in general. On average, two rice technologies were generated per year while 10 publications were produced. Analyses on technologies and the publications of a specific commodity have been neglected over the years. A suitable platform for publications should be made available to all research disciplines as most rice articles (106 articles) were published in the *Buletin Teknologi Padi* which was published for only 12 years (1985 – 1996). The number of publications for every technology cannot be determined precisely.

Nevertheless, every project should be monitored in terms of funding, publications produced and technologies generated.

This will ensure the research project is successfully carried out and monitored effectively and efficiently. There are no data ever reported on the number of technologies generated and publications produced by a project or a researcher over a given time or period of his/her career. Nevertheless, the number of publications published should be in par with the number of technologies generated and conforms to MARDI's function.

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### **Abstrak**

MARDI telah menjalankan penyelidikan dan pembangunan (R&D) tentang padi sejak penubuhannya pada 1969. Teknologi yang dijana dipindahkan dan disebarkan untuk faedah petani dan orang awam. Salah satu cara pemindahan teknologi adalah melalui penerbitan. Kajian ini menilai pertalian antara aktiviti R&D dengan penerbitan padi oleh penyelidik MARDI. Data dikumpulkan daripada semua penerbitan MARDI dari 1973 hingga 2010 (38 tahun). Kajian ini mendapati 79 teknologi tentang padi telah dijana dengan purata dua teknologi setahun dan kebanyakannya dalam pembangunan varieti. Dalam tempoh yg sama, 374 artikel padi telah diterbitkan dalam jurnal, buletin, laporan, buku, manual dan majalah MARDI. Secara purata, 10 artikel diterbitkan setahun dan kebanyakannya dalam bidang agronomi. Kebanyakan artikel diterbitkan dalam buletin (39%) dan jurnal (36%). Kesimpulannya, terdapat pertalian yang kuat antara aktiviti R&D dengan penerbitan berkaitan padi. Teknologi dan pengetahuan baru tentang padi telah disebarkan dan dikongsi antara penyelidik dengan kumpulan sasaran.