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ICHARM

International Centre for Water Hazard and Risk Management under the auspices of UNESCO

ICHARM PWRI UNESCO United Nations Educational, Scientific and Cultural Organization

Contents

Message from Director

All ICHARM members started the new year with refreshed minds and striving for disaster risk reduction.

On January 12-14, I visited the areas affected by tsunamis following the Great East Japan Earthquake. After meeting many people who are working hard in the biting-cold weather of their second winter, I strongly felt that reconstruction of the damaged areas is far behind. Although a large amount of money is set aside for reconstruction and all Japanese are supporting reconstruction efforts, I did not see much progress. There were some exceptions, including removal of rubble and restoration of industrial facilities supporting fisheries, commerce, transportation, oil refinery, and other manufacturing. But destroyed housing areas are still left largely untouched with countless numbers of house foundations lying vacant, one after another.

I talked with many local people, including people who are living in temporary housing, people who had narrowly escaped the tsunamis, and others who are city employees working on a holiday shift, etc, and I found that the reconstruction has been slow because reaching consensus on plans for local redevelopment is a time consuming process. Such plans involve a long list of issues for decisions, including such factors as relocation to higher ground, redevelopment of affected areas, as well as related land-use regulations and land ownership adjustment. There are many factors that local decision makers must consider, for instance, future plans of the region under discussion and not-yet-customized national policies for development and subsidization. Once reconstruction starts, there is no return. As such, there is little room for hasty actions.


Little reconstruction at Tanni-Village, Iwate on 13 January 2013

I was really impressed with people and local municipalities that are thinking far ahead to 100 or even 1000 years into the future and striving for the implementation of well-thought-out plans despite being in the extremely difficult situations. In this patient process, I saw their determination, possibility and overall strength as they work towards future local prosperity and rebuilding of safe communities. Knowing that people in the affected areas have experienced a long, hard struggle, ICHARM too would like to help them finalize reconstruction plans with bright prospects as soon as possible by providing our expertise following the mottos: “Build Back Better” and “Build Back Stronger, Safer and Smarter”.

31 January 2013
Kuniyoshi Takeuchi
Director of ICHARM
竹内邦良

新年を迎え、ICHARM 一同、心も新たに、世界の防災のための活動に邁進しています。

1 月 12-14 日、東北大震災の津波被災地を訪れました。厳しい 2 度目の冬に耐え、先行き不透明なまま黙々と働いておられる多くの方々に接し、復興の遅れを強く感じました。大型の復興予算が組まれ、国民みなが応援していますが、現地での復興作業は一部を除き、進んでいるようには見えませんでした。瓦礫や廃墟の撤去作業、漁業や一部の商工業の施設・建物の再建工事は見られますが、被災住宅地の再開発は手つかずの状態で、家々の土台の残骸が続いていました。

仮設住宅の人、かろうじて難を逃れた住人、市役所の休日出勤の職員など、いろいろな人に話を聞きましたが、復興が進まない理由は「復興の街づくり案の合意に時間がかかっているから」のようです。高地移転、被害地の再開発、それに伴う土地利用規制、区画整理など多くの決定事項があり、これらには地域の将来構想、国の開発・助成方針もかかわっています。一度再建を始めれば引き返すことはできません。拙速は許されず、決定に時間がかかるのもある程度やむを得ません。

私どもが感心したのは、そのような将来構想のために、当面の不自由に堪え、100 年の計、1000 年の計に取り組んでいる人々、自治体です。この辛抱強い復興プロセスの中に、地域の将来発展、安全なまちづくりへの意欲と可能性、総合力を感じました。現在をじっと耐え、忍んでおられる住民の皆さんの役に立てるよう、一日も早く夢のある構想の具体案が成立するよう、ICHARM も知恵を出し、Build Back Better、Build Back Stronger, Safer, Smarter に 協力していきたいと思います。

Research

ICHARM Researcher Conducts Hurricane Sandy Damage Investigation

2012 年 10 月 29 日から 31 日に米国で 113 人の犠牲者を出したハリケーン・サンディの現地調査を報告します。浸水と火災の被害を受けたニュージャージー州とニューヨーク州を被災から約 1 か月後に 4 日間の調査をしました。被災地ではまだ支援物資を配給する姿が見られました（写真 1）。

被害の概要：ハリケーンは 10 月 29 日、東部標準時刻 20 時頃最高風速約 36m/s でニュージャージー州アトランティックシティ近くに上陸しました（NOAA）。2 日間で降水量は 160mm、最高水位は 4 mを記録（月降水量平均 88.1mm）（USCAE）。経済損失推定額は 500 億ドルになりました。ニューヨークにこの規模のハリケーンが上陸したのは、1938 年以来です。米国では、上陸の何日も前から経済活動を停止し街全体に避難勧告を出すため、災害弱者である高齢者と子供の死亡者数が 50 代男性より低くなったと考えられます（図 1）。折れ線グラフで示した東日本大震災の被害者傾向と比べて著しく異なります。50 代男性の死亡要因のトップは感電死や倒木や交通事故などのアクシデントに巻き込まれたためで、溺死ではありません（NYC 警察）。

都市化した災害脆弱性の問題：被災後 1 か月近く経つにも関わらず、地下鉄に海水が流入して閉鎖している駅の有る線が 2 つありました。定年退職した高齢者が多く住む日当たりのよい海岸沿いのマンションの多くが被災して閉鎖されていました。マンハッタンの突端の超高層高級アパートでさえ、電気設備は地下にあったため、まだ閉鎖され住民が戻れない所が多くありました。マンハッタンで浸水予防対策をして、今回浸水を免れたビルは、ゴールドマンサックス等 2 つだけでした（コンサルタントの聞き取り）。要因としては、1978 年法に基づいて組織された防災委員会が、2005 年から報告書で都市の災害脆弱性を警告していたにもかかわらず、ニューヨークでは無視されて事前対策が行われてなかったからです（Guardian）。

原子力発電所：オイスター・クリーク原子力発電所では、4 段階の米国の原子力の警報として下から 2 番目の警戒レベルが出されました。現地で視察して驚いたのは、取水と排水を行う河川に堤防が全くなかったことです（写真 2）。米国から輸入した原子力施設がその国のハザードに合わせた規制しかないことを現地に行って改めて認識しました。

まとめ：都市の脆弱性に対して、対策を怠った顕著な特徴が多く見受けられました。首都直下地震等日本の都市対策に生かすべき点を精査し、反映していく必要があります。

ICHARM Research Specialist Megumi Sugimoto visited the United States for the Hurricane Sandy Damage Investigation in November 2012. She has contributed a brief report of the investigation as follows:

Hurricane Sandy hit the eastern coast of the United States and caused devastation there during October 29-31 2012, killing 113 people. I investigated affected areas during November 20-23. When I arrived there about one month after the disaster, I saw people still distributing relief supplies (Photo 1).

Photo1: Volunteers for foods distributions in Rockaway Park N.Y.

Overview of damage: Hurricane Sandy landed somewhere near Atlantic City in the state of New Jersey around 20:00 (EST) in October 29 with a maximum wind speed of about 36 m/s (NOAA). The two-day rainfall was reported to have reached 160mm and the water level rose up to 4m (monthly mean rainfall: 88.1mm). The economic losses were estimated at 50 billion dollars (EQECA). Hurricane Sandy became the first hurricane of this size that ever hit New York since 1938. From several days before its landing, the city halted economic activities and repeatedly issued an evacuation advisory. The effort is thought to have resulted in saving disaster vulnerable people such as seniors and children while men in 50s marked the highest fatality in the disaster (Figure 1), which is very different from the case of the Great East Japan Earthquake and Tsunami (GEJET). In addition, according to the New York City Police Department, the top cause of their deaths is accidents including electrocution, being hit by falling trees and traffic accidents, rather than drowning.

Urbanization as vulnerability: Even about one month after the disaster, some stations on two subway lines were still closed because they were still inundated by sea water. Also closed were many condominiums for retired seniors built on sunny, coastal areas. Even superhigh-rise condominiums at the tip of the Manhattan Island were closed, for their electric facilities had been flooded because they are in the basement. Consultants told me that only two buildings in Manhattan (one of them is Goldman Sachs') survived a widespread inundation because they had taken flood prevention measures. The Gurdian reported that infrastructures were seriously damaged by flooding because prevention measures were largely ignored in New York despite that its disaster management committee had repeatedly warned of the city's flood vulnerability in its reports since 2005.

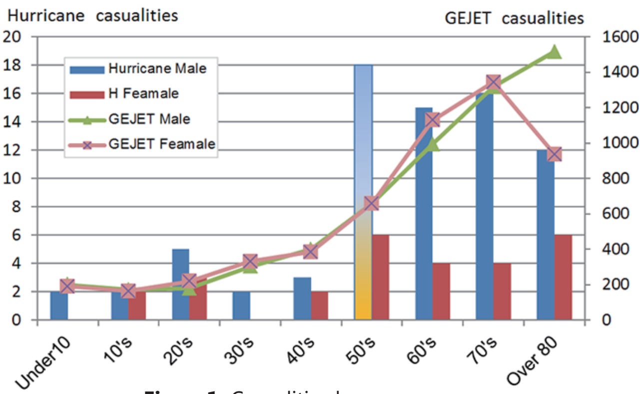


Figure1: Casualities by age group
Those of unknown age and whose age their families did not disclose are excluded.
(Source: 2012 Disaster preventions white papers Japan and NYC)

Nuclear Power Plant: At the Oyster Creek nuclear power plant, a level-2 warning was issued regarding the storm; the warning was the second lowest of the four-level warning system currently employed for nuclear facilities in the United States. What surprised me was that there were no levees along the river that the plant uses for water intake and discharge (Photo 2). This reminded me of some nuclear facilities in Japan built by foreign constructors that have been pointed out for not having adequate protection against water hazards. Such facilities, though built in a different environment, may have been regulated in a similar way that they are regulated in the original environment.

Photo2: Oyster Creek nuclear power plant in New Jersey

Conclusion: In this investigation, I saw many cases that typically originated in the ignorance of taking necessary measures for urban vulnerability to certain hazards. It is very important that we should take a close look at the investigation results for lessons to improve urban resilience to various hazards such as a powerful inland earthquake expected to occur in the Tokyo metropolitan area and in other parts of Japan.

(Written by Megumi Sugimoto, Project led by Toshio Okazumi)

MEXT-funded Kakushin Program Report

Part 3: Global-scale Climate Change Impact Assessment on Flood Risk Change

ICHARM participated for five years from 2007 to 2011 in the Innovative Program of Climate Change Projection for the 21st Century (the Kakushin Program), funded by the Ministry of Education, Culture, Sports, Science and Technology (MEXT). In the program, ICHARM conducted research entitled "Assessment of the Impact of Climate Change on Flood Disaster Risk and its Reduction Measures over the Globe and Specific Vulnerable Areas." In this issue, following the previous two reports (see ICHARM Newsletters No.24 & 26) on global prediction of changes in the flood hazards of rainfall and flood runoff, we will briefly report on the development of a model to assess changes by climate change in flood risk such as human and economic damage, as well as research results obtained by using the model.

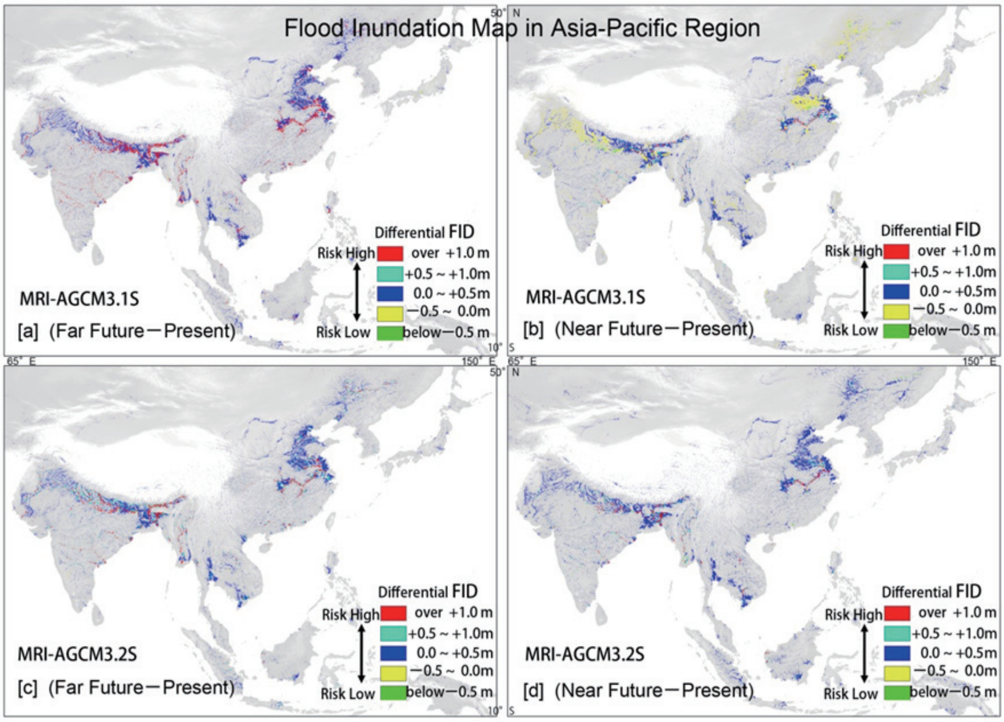


Figure 1 Changes in potential inundation depth (FID) and area in the Asia-Pacific region (50N-10S, 65E-150E) under climates of Near Future and End-of-21st Century based on MRI-AGCM3.1S (a, b) and on MRI-AGCM3.2S (c, d).

Flood discharges in river channels can be calculated by giving GCM-based projected rainfall to the global flood runoff analysis system based on the BTOP model. The next step is to identify areas where an overflow may occur at a high water level caused by a certain level of flood discharge.

To do this, we first prepared data to calculate surface flow directions and water levels corresponding to river discharges by using HydroSHEDS (WWF, USGS) 15s (spatial resolution: 500m, vertical resolution: 1m) developed by the U.S. Geological Survey. We then developed a flood inundation depth (FID) model to identify potential flooding areas that may be inundated as a result of an overflow at a certain location of the river channel when the river water reaches the water level corresponding to a certain flood discharge. This model is unique in that it is capable of effectively identifying all areas on a global basis that may be inundated by a given flood hazard, since it requires no flood inundation simulation that is usually very complicated in both hydrologic and hydraulic senses. Flood risk can then be assessed by overlaying a potential flooding area over vulnerability data such as population and development.

Figure 1 shows potential flood-risk areas[1]. On the Asian Continent, the potential flooding areas are projected to increase from the near future to the far future periods (the end of the 21st century). However, a high level of uncertainty is also suggested from the difference between the results of the simulations that used different GCM outputs. The potentially affected population is also estimated to increase up to 6.1% (0.35 million) in the Asian region towards the end of the 21st century (Table 1), though the estimations vary depending on GCM outputs.

Table 1 Changes in potential flood-risk area and potentially affected population in Present, Near Future and End-of-21st Century (Target areas with the population density of 1 person per km² or over in Asia)

Potential risk / Asia area	MRI-AGCM3.2S BC				MRI-AGCM3.1S BC			
	Hazard area(km²)	Change (%)	Affected People	Change (%)	Hazard area(km²)	Change (%)	Affected people	Change (%)
Present (2075-2099)	1,880,000	+4.2	611,300,000	+6.1	1,850,000	+3.4	594,600,000	+4.9
Near Future (2015-2039)	1,840,000	+1.6	590,000,000	+2.4	1,790,000	+0.4	572,600,000	+1.0
End of 21st Century (1980-2004)	1,810,000		576,200,000		1,790,000		566,700,000	

(Written by Youngjoo Kwak, Project Led by Kazuhiko Fukami)

ICHARM は，平成 19 年度から 23 年度の 5 年間、文部科学省 21 世紀気候変動予測革新プログラムに参画し、「気候変動に伴う全球および特定脆弱地域への洪水リスク影響と減災対策の評価」の研究を実施しました。ここでは、Newsletter 第 24、26 号で紹介した降水量および洪水流出量などの洪水ハザードの全球規模の変化予測結果を受けて、洪水による人的・経済的被害が洪水リスクの気候変動による変化を全球規模で評価するモデルの開発およびその成果について紹介します。

河川を流下する洪水流量は、BTOP モデルを基盤として構築した全球洪水流出解析システムに GCM による降水量予測値を与えることで得ることができます。次に、ある流量が河川を流れて高い水位になったときに洪水が氾濫する可能性のある地域を抽出します。そこで、アメリカ地質調査所 (U.S. Geological Survey) が整備した HydroSHEDS(WWF,USGS) 15s(空間解像度 500 m、鉛直方向の解像度 1 m) をもとに、表流水流下方向と流量から水位へ変換するための必要データを整備しました。次に、河川の任意地点で、水位があるレベルに達した際に起こりえる氾濫想定域を抽出する簡便な手法を開発しました。この洪水リスク評価相対比高モデル (Flood Inundation Depth=FID model) は、水理・水文学的に複雑な洪水氾濫シミュレーションを行う必要がないため、与えられた洪水ハザードのもとでの最大限の洪水氾濫域を全球規模で効率的に評価できる特長があります。このように氾濫想定域を抽出し、人口や開発地といった脆弱性データと重ね合わせることにより、洪水リスクを評価することができます。

図 1 にアジア・太平洋地域における氾濫想定域を示します。これからも分かるように、アジア大陸では、近未来から 21 世紀末に向けて氾濫想定域が増加する予測となっていますが、異なる GCM による気候変化予測結果の違いによる不確実性も大きいことがわかります [1]。洪水被害の影響を受ける人口も GCM による違いがあるものの、表 1 に示すように 21 世紀末に向けてアジア域で最大 6.1% (3,500 万人) 程度増加する可能性を示す試算結果となりました (人口は 2009 年時点のデータで固定)。

1) Y. Kwak, K. Takeuchi, J. Fukami, J. Magome, "A New Approach to Flood Risk Assessment in Asia-Pacific Region Based on MRI-AGCM Outputs", Hydrological Research Letters 6, pp.55-60. 2012.

Research

MEXT-funded Kakushin Program Report

Part 4: Assessment of climate change impact on the lower West Rapti River basin

ICHARMで実施した革新プログラムの研究成果のうち、これまでは、全球スケールでの降雨量や洪水流出量、洪水氾濫と被害に関するマクロな評価についての成果の一端を紹介してきました。ICHARMでは、それらに加えて、特定脆弱地域、すなわち、洪水リスクの変化を直接被ると考えられる具体的な河川流域でのローカルな事例研究も実施しました。本号ではまず、ネパールの西ラプティ川下流での研究事例を紹介します。当該地域は、ネパール国の経済発展にとって重要な流域ですが、これまで洪水氾濫の被害をたびたび受けています。ICHARMは、この流域を対象として、地球温暖化が洪水氾濫原での洪水リスクに及ぼす影響の研究を進めました。

本研究は、IPCCのSRES A1Bシナリオの下、MRI-AGCM3.2sを用いて予測した異常洪水に起因する将来の家財および農業被害に焦点を当てています。研究では統合的なモデリング手法を採用し、高解像度（20km）MRI-AGCM3.2sによる計算結果をもとに、ICHARMが開発した2種類の流域規模水文モデル（IFAS, RRI）を駆使しました。まず、現在（1980-2004）、近未来（2015-2039）、未来（2075-2099）という時間区分毎にバイアス補正したMRI-AGCM3.2sの降水量データを境界条件とし、IFASで河川流量を計算しました。次に、その計算流量に対応する50年洪水流量を算出、さらに、この50年洪水流量による浸水シミュレーションをRRIモデルを使って行いました。図4にその浸水深図を示します。

平行して、プロジェクトのネパール側協力機関であるネパール開発調査研究所（NDRI）は、ICHARM研究員と共に、対象地域で社会経済面の現地調査を実施し、過去の洪水による家財および農業被害に関する情報を収集、その結果をもとに、被害曲線を作成しました。図2は家財被害、図3は水田被害に関するグラフです。

以上の計算をもとにして、将来予測される家財および農業被害を、図5および図6のように算出することが可能になりました。

In parts 1-3 of the Kakushin Program report, we have shared with the readers part of the results on global changes in rainfall and flood discharge and on the macro assessment of inundation and damage. In the program, we also conducted case studies on specific vulnerable areas, i.e., local river basins that may be subject to direct impact of flood risk changes. In this issue, we briefly introduce the case of the lower West Rapti River basin in Nepal. This basin, though prone to frequent flood damage, is very important for the country's economic development. ICHARM carried out research to understand the impact of global warming on changes in flood risk over the flood plains in this basin.

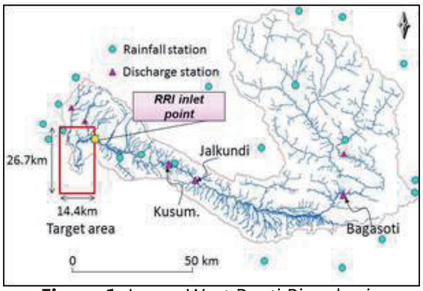


Figure 1: Lower West Rapti River basin

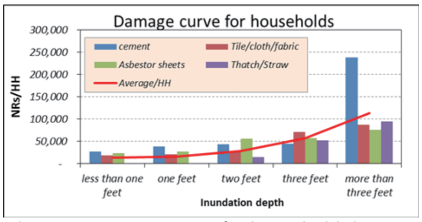


Figure 2: Damage curve for household damage

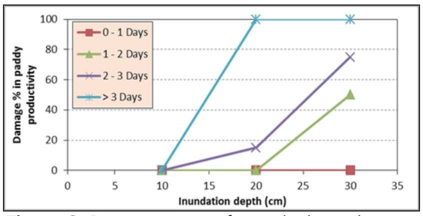


Figure 3: Damage curves for agriculture damage

The lower West Rapti River basin (Figure 1), a very dynamic and economically important basin of Nepal, was selected as the target basin by ICHARM for the KAKUSHIN research program to understand the impact of global warming and climate change on a localized scale.

The study focused on future household and agricultural damages induced by extreme flood events projected under the IPCC SRES A1B scenario by the Meteorological Research Institute, Japan-Atmospheric General Circulation Model 3.2s (MRI-AGCM 3.2s). An integrated modeling approach was executed to achieve the research purpose by utilizing the results from high-resolution 20 km MRI-AGCM 3.2s with two watershed hydrological models developed in ICHARM (IFAS and RRI). Bias-corrected MRI-AGCM 3.2s precipitation outputs for Present-SPAC (1980-2004), Near Future-SNAC (2015-2039) and Future-SFAC (2075-2099) were used as boundary conditions for IFAS(Integrated Flood Analysis System) to generate river runoff. A frequency analysis was carried out to obtain 50-year return period flood discharges in the lower West Rapti basin for the simulated discharges from IFAS. Inundation simulations for the 50-year return period flood discharges were carried out by using the RRI model.

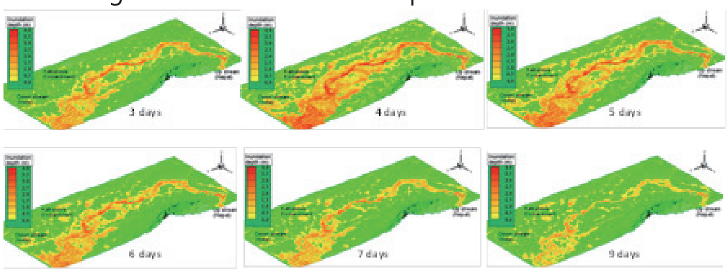


Figure 4: Inundation maps for the 50-year return period flood for Future

The Nepal Development Research Institute (NDRI), the Nepalese counterpart of the project, carried out a socio-economical field survey in the target area to collect information on previous flood damage to households and agriculture with the ICHARM staff. Based on the field survey information, damage curves were prepared. Figure 2 depicts the household damage while Figure 3 describes the damage to paddies in the lower West Rapti River basin. Possible Future damages to households and agriculture were estimated by utilizing the flood depths obtained by the inundation maps (Figure 4) and thay are shown in Figure5 and 6.

(Written by Duminda Perera, Project led by Kazuhiko Fukami)

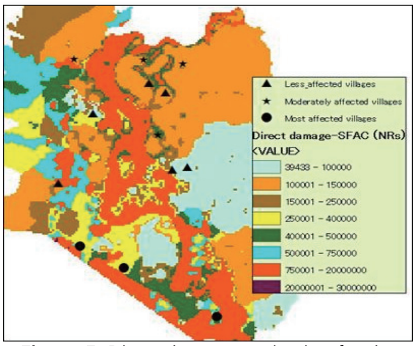


Figure 5: Direct damage projection for the 50-year return period flood event for Future

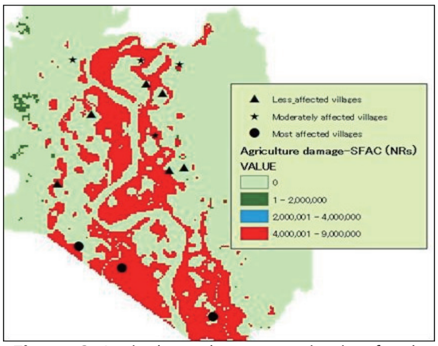


Figure 6: Agriculture damage projection for the 50-year return period flood event for Future

Capacity Development

FY2012 JICA Training Program: Capacity Development for Flood Risk Management with IFAS

ICHARM conducts different types of training program as one of its three principal activities mainly in collaboration with the Japan International Cooperation Agency (JICA). In FY2012 ICHARM implemented another JICA training program, "Capacity Development for Flood Risk Management with IFAS," which is scheduled to be provided for the next three years. Last year, this new program was conducted twice: first from 10 July to 7 August and second from 26 November to 11 December.

The program is designed to provide opportunity for meteorologists, river administrators and disaster management officers in flood-vulnerable developing countries to learn the use of the IFAS, developed and upgraded by ICHARM. The other important purposes are to learn about disaster management and evacuation plans and flood response cases in Japan, and to develop an action plan for local flood management of flood-vulnerable areas in the participants' countries. These training activities aim to enhance individual flood-coping capacities and eventually to contribute to flood damage mitigation in their countries.

The participants, JICA staff, and ICHARM staff pose for photos at the closing ceremonies.

One of the unique points of this training program is that the target participants are to be selected from those who are currently working at organizations involved in the JICA flood local projects to create as great synergy as possible. Last year, thirteen people (three each from Bangladesh, Kenya and Thailand and two each from Nigeria and the Philippines) participated for the first training period and seven from Vietnam for the second training period.

The program consists of four main components: lectures, practices, study visits, and presentations and discussions. At the end of the program last year, many of the participants listed the study visit in the downstream area of the Shinanogawa River as the most impressive. Some pointed out a high level of commitment, behavior, attitude and readiness in Japan's flood management.

For more detailed reports for each training period, visit the ICHARM web site.

(Written by Daisuke Kuribayashi)

ICHARMは、活動の三本柱の一つに「研修活動」を掲げており、主に（独）国際協力機構(JICA)と協力して各種研修を実施しています。その一環として、2012年から3か年計画で標記研修を開始し、2012年には7月10日から8月7日にかけてと、11月26日から12月11日にかけてそれぞれ実施しました。

本研修の目的としては、途上国の洪水脆弱地域における気象関係者・河川管理者・住民避難に責任を持つ者の3主体を対象とし、ICHARMが開発を進めているIFASの利用法を習得させるとともに、我が国における防災・避難計画の概要や洪水対応事例を学んで自国の洪水脆弱地域を対象とした地域洪水防災計画案を策定し、彼らの洪水対応能力向上を図り、ひいては洪水被害軽減に資することとしています。

また、本研修の大きな特徴として、現地国のJICA洪水関連プロジェクトと相乗効果を出来るだけ高く発揮するために、参加者を当該プロジェクトに直接関係する機関の者に絞ったことが挙げられます。この結果、7月の研修ではバングラデシュ・ケニア・タイから各3名、ナイジェリア・フィリピンから各2名の計13名、12月の研修ではベトナムから7名の研修生がそれぞれ参加しました。

本研修はそれぞれ講義、演習、現地視察、発表・議論の4要素から構成されました。研修後の研修生のアンケートでは、新潟県信濃川下流域の現地視察が本研修で最も印象的であったとの回答を得るとともに、防災に対する日本の"commitment（責任、関与）"、"behavior（行動）"、"attitude（態度）"、"readiness（準備）"の強さを指摘する意見もありました。

各研修の詳細な内容については、ICHARMのホームページをご覧ください。

Filipino researchers visits ICHARM for training (Contribution)

In November 2012, Mr. Hilton T. Hernando, assistant weather services chief, and Mr. Hilario G. Esperanza, weather specialist I, both from the Philippine Atmospheric, Geophysical & Astronomical Services Administration (PAGASA), visited ICHARM for technical training. They kindly contributed a short report on their training to this issue of the ICHARM Newsletter.

In November 12-20, 2012, we visited ICHARM for the Flood Inundation Analysis training. This training was a follow-up activity of a previous training event, "Capacity Development for Effective Management in River Basins of the Philippines," held last September and October in the Philippines in collaboration between the Asian Development Bank (ADB) and ICHARM. These training opportunities are planned by

2012年11月、フィリピン気象天文庁（PAGASA）の職員2名がICHARMで洪水氾濫解析の研修を受けられました。以下は、その研修の内容をお二人に報告して頂いたものです。

私たちPAGASA職員2名は、2012年11月12～20日、「洪水氾濫解析」の研修を受けるため、ICHARMを訪れました。この研修は、昨年9～10月、ICHARMの協力を得てアジア開発銀行（ADB）がフィリピンで実施した研修「フィリピンの河川流域の

効果的な管理に関する能力開発」のフォローアップ研修として実施されました。また、両研修とも、ADBによる「Knowledge and Innovation Support for Water Financing Program」に関する研修プログラムの中に位置づけられています。

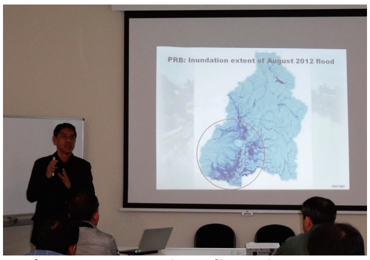
今回の研修では、降雨流出氾濫（RRI）モデルをパンパンガ川流域に適用することを念頭に、昨年9月の台風Pedringによる洪水データをもとにモデルの補正を、8月の南西モンスーンによる洪水データをもとにモデルの検証を行いました。また、両洪水時の対象河川流域データをもとに、モデルパラメータの解析も行いました。

RRIモデルは、ICHARMで開発した、降雨流出プロセスと洪水氾濫を同時にシミュレーションすることが可能な二次元モデルです。このモデルでは、斜面と河川を分けて処理します。斜面と河川の流入・流出作用は、水位、堤防の高さ等の諸条件によって異なる越流式を用いて計算されます。地中流（側方地中浸透および鉛直浸透）も計算され、降雨・流出プロセスを物理的に表現します。地中流の計算は、一次元拡散波河川追跡やスロープモデルとの相互作用の解析にも利用されます。RRIモデルでは、ARCGISとFORTRANを用いて、様々なステッププロセスを実行しています。

モデルパラメータの補正は、台風Pedringの影響を受けたパンパンガ川流域内にある複数の観測施設から入手した時間降雨および水位データをもとに、計算を繰り返して行いました。補正を行うにあたって、飽和地表流、飽和地中流、河道に関するマニングの粗度係数、浸透深、河川水路幾何学に関する設定については特に注意を払いました。その後、補正されたパラメータを昨年8月の洪水に適用し、検証しました。研修では、さらに、パンパンガ川流域の北西に隣接する比較的小さな流域であるアグノ川流域に、RRIモデルを適用するための作業も開始しました。

研修の最後には、シミュレーション結果のプレゼンテーションをICHARM職員に対して行いました。プレゼンテーションでは、パンパンガ川流域の概要、PRFFWシステム、2011年および2012年に発生した洪水、複数のモデルを利用したシミュレーション結果、2011年・2012年洪水のシミュレーション結果、RRIモデルの継続利用に関する計画や活動について発表しました。プレゼンテーションやシミュレーション結果は以下のアドレスから閲覧できます。http://prffwc.synthasite.com/resources/RRI-PRB%20simulations-nov2012.pdf

今回ICHARMで実施された研修は、私たちのニーズに合わせて計画され、参加者も私たち2名のみでした。このような研修は非常に稀で、誰もが受けられるというものではありません。研修活動は、対象をパンパンガ川流域に絞って準備され、実施されました。研修期間としては短く、その期間つくばは寒かったのですが、私達はICHARMのみなさんのすばらしい心遣いを感じながら過ごすことができ、研修自体も非常に充実したものとなりました。

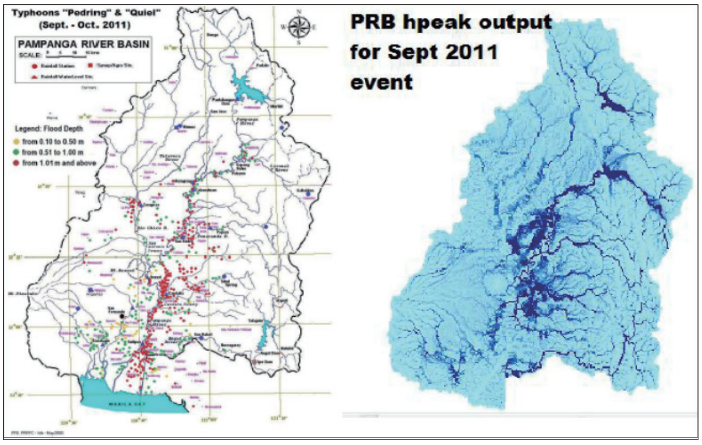


ADB as a part of its technical assistance program, "Knowledge and Innovation Support for Water Financing Program".

The Flood Inundation Analysis training was mainly focused on the application of the Rainfall-Runoff-Inundation (RRI) model to the Pampanga River basin. We used two specific flood cases in this technical training; the flood events during Tropical Cyclone Pedring (September 2011) for model calibration and those during the southwest monsoon (August 2012) for model validation. We worked on the analysis of the model parameters by using the data from the Pampanga River basin for both events.

The RRI model is a 2D rainfall-runoff-inundation model developed by ICHARM that is capable of simulating the rainfall-runoff process and flood inundation simultaneously. The model deals with slopes and river channels separately. The inflow-outflow interaction between the slope and river is calculated based on different overflowing formulae depending on water-level and levee-height conditions. Subsurface flow (lateral subsurface and vertical infiltration) is simulated for physical representations of rainfall-runoff processes; and the one dimensional diffusive wave river routing and its interaction with the slope model. The model uses both ARCGIS software and a FORTRAN Compiler in running various step processes.

The model parameters were calibrated on several runs by using hourly rainfall and water level data from stations in the Pampanga River basin during the flooding caused by Tropical Cyclone Pedring. We paid particular attention to several parameters such as saturated surface and subsurface flow, the Manning's roughness in the channel, the infiltration depths and the setting of the river channel geometry. The calibrated parameters were then used to simulate the August 2012 flood event for validation. We were also able to start some preparation for the application of the RRI model to the Agno River basin, an adjacent relatively smaller basin at the northwest of the Pampanga River basin.



(left) The flood extent map of the Pampanga River basin during the September 2011 flood event
(right) The flood peak extent (indicated in blue) simulated by using the RRI model during the September 2011 food event

At the end of the training, we had a presentation on our training results in front of ICHARM researchers. We explained about the Pampanga River basin, the PRFFW system, the flood events of 2011 and 2012, the results of several model runs, the simulated results for both flood events, and finally proposed plans and activities on the further application of the RRI model. The presentation and simulated inundation results are available at: http://prffwc.synthasite.com/resources/RRI-PRB%20simulations-nov2012.pdf

The training this time was very special in that we were the only participants and that it was specifically customized for our needs and conditions. It was truly a rare opportunity. Although the training period was rather short and the weather of the time was relatively cold, both of us enjoyed the warmth and unparalleled hospitality of our ICHARM friends, which made the whole program worthwhile and enjoyable.

(Written by Hilton T. Hernando, assistant weather services chief and Hilario G. Esperanza, weather specialist I, Philippine Atmospheric, Geophysical & Astronomical Services Administration (PAGASA))

Project Updates

Training on “Development and Utilization of Flood Vulnerability Indices in Cambodian Floodplain” (ADB TA 7276)

ICHARM organized a training program, “Development and Utilization of Flood Vulnerability Indices in Cambodian Floodplain,” jointly with the Mekong River Commission Secretariat (MRCS), the Cambodia National Mekong Committee (CNMC), and the Asian Development Bank (ADB) on December 11-13, 2012, at MRCS in Phnom Penh, Cambodia. About 20 participants attended this training from various related organizations of Cambodia such as MRCS and CNMC.


Group photo of participants

This training program focused on developing the capacity of flood management to carry out Flood Vulnerability Indices (FVI) mapping and to best utilize the results in development practices. FVI is designed to identify areas which are easy to be affected by floods and support everyone to assess vulnerability to flood disasters in river basins. It can be an important policy-making tool for raising awareness, assisting governments in priority setting, and guiding international organizations in directions of involvement. The effective application of this useful tool to the Lower Mekong basin was also discussed among the participants, which will eventually lead to the development of a guidebook. ICHARM developed the original FVI by combining hydro-metrological analysis, GIS methodology and other widely available data. In the development of a local FVI for Cambodian floodplains under the ADB TA 7276 project, flood vulnerability was defined in terms of the amount of potential damage to agriculture and household property. Agricultural damage was defined as the function of flood water depth and flood duration during the cultivation period. Household damage was defined as the function of maximum flood water depth in relation to average yearly flood level. The household survey data on the 2006 flood, provided by the Flood Management and Mitigation Programme (FMMP) of MRCS, was used to determine a damage ratio curve and probability distribution of house value. Two sets of FVI were developed for average and extreme flood cases.


Hands-on training of development of FVI

Based on the post-training questionnaire survey with the participants, about 86.6% of them felt that they were able to understand the philosophy behind the development of the ICHARM Hydro-Geo Method (IHGM). All the participants stated that they understood flood vulnerability indices, and commented that FVI maps are very useful for flood risk management. About 93% said that the training is helpful for flood management.


Participants during hands-on training

The main outcomes of this training program are as follows: sharing methodologies and hands-on training of IHGM, agricultural damage assessment, house damage assessment, development of flood vulnerability indices and application of GIS tools for FVI development; leveraging knowledge sharing for capacity development; and providing knowledge for effective utilization of FVI as a tool for community people, community leaders, decision makers, policy makers and developers for disaster management.

We hope that all participants will share knowledge of these methodologies and FVI with other staff in their organizations to utilize them more for disaster management in order to support investment for disaster management.

(Written by Badri Shrestha, Project led by Toshio Okazumi)

ICHARM は、2012 年 12 月 11 ～ 13 日、カンボジアの首都プノンペンにあるメコン川委員会事務局（MRCS）で、「カンボジアの氾濫原を対象とした洪水脆弱性指標（FVI）の開発と利用」という研修を実施しました。この研修は、MRCS の他、カンボジア国内メコン委員会（CNMC）、アジア開発銀行（ADB）の協力のもと実現しました。研修にはおよそ 20 名の参加者が、MRCS、CNMC などカンボジアのさまざまな関係機関から集まりました。

この研修の主眼は、FVI 地図を作成し、その成果をカンボジアの開発に最大限に利用するのに必要な洪水管理に関する能力を強化することでした。FVI は、洪水の影響を受けやすい地域を特定し、流域内の洪水災害に対する脆弱性評価を支援することを目的に開発されました。住民の意識向上、政策の優先順位決定に関する政府支援、国際機関参画の際の方向付けなど、非常に有力な政策立案支援ツールとなり得ます。研修では、FVI のメコン川下流域への効果的な適用法も議論されました。こうした議論を重ねて、最終的には FVI 利用に関するガイドブック作成が予定されています。原型となる FVI は、水文気象分析、GIS 手法、さらに世界的に広く利用されているデータを組み合わせて ICHARM が開発しました。ADB TA 7276 プロジェクトのもと、カンボジアの氾濫原を対象にした FVI を開発するにあたっては、洪水脆弱性を農業や家屋・家財について予想される被害という視点から定義しました。農業被害は、栽培期間中の洪水深と洪水期間の関数、家屋の被害は、平均年洪水位との関連でみた最大洪水深の関数としました。家屋の価値に関する被害率曲線と確率分布の決定には、MRCS の洪水管理・軽減計画から得た 2006 年洪水時の世帯調査資料を利用しました。最終的に、平均的な洪水用と最大洪水用に 2 組の FVI を作成しました。

研修後に参加者対象に実施したアンケート調査では、参加者の 86.6% が、ICHARM の水文地理手法（IHGM）開発の考え方を理解できたと答えました。また、FVI については、参加者全員が理解したと答え、FVI 地図は洪水リスク管理に非常に有益であるということでした。研修についても、93% が洪水管理に有益だという感想でした。

今回の研修成果としては以下の項目が挙げられます。IHGM、農業被害評価、家屋被害評価、FVI 開発、FVI 開発用 GIS ツールの利用に関する手法の解説および実習の実施、能力開発のための知識共有、地域住民・指導者、意思決定者、政策立案者、災害管理担当者らへのツールとしての FVI 有効利用に関する情報提供などです。今後、参加者が各手法や FVI に関する知識を所属機関の職員と共有し、災害管理に更に有効利用し、災害管理に対する投資を支援していくことを願っています。

Other Topics

New ICHARM Members

Six new members joined ICHARM. They would like to say brief hellos to the readers around the world.

Sangeun Lee

Research Specialist — *South Korea*

I have devoted myself to studying adaptation of water resources system to disturbances such as climate change impacts, and sudden socio-economic surprises. At ICHARM, I have a role of developing water-related risk indices. Before long, I'll try to combine these indices with system simulation methods, and then develop a water-related risk scenario generator.

Hideyuki Kamimera

Research Specialist — *Japan*

I have been doing the study of regions mainly in monsoon Asia, with hydro-meteorological observation and modeling, to understand region- and case-specific water-disaster problems and solve them. This activity corresponds to ICHARM's principle of "localism". I hope that I can contribute to water-disaster mitigation in many regions of Asia and the world.

Maksym Gusyev

Research Specialist — *Ukraine*

I am hydrologist with academic background in chemistry, engineering and environmental sciences and have broad research interests and teaching experience. My key expertise is the development and application of numerical models to enhance our understanding of water hazards and to provide information for the implementation of hazard mitigation strategies.

Kelly Kibler

Research Specialist — *United States of America*

I have come to ICHARM from Oregon State University in the United States. I am a hydrologist and engineer, and my past research has investigated hydro-geomorphic effects of dams. I hope to contribute to ICHARM research and training activities, and to develop global capacity in sustainable management of river basins and water infrastructure.

Fernandez Reynosa Rodrigo

Research Assistant — *Guatemala*

I joined ICHARM's Ph.D. Program in October. I will research about the water cycle and the interaction of its individual components, the effects of human activity and climate, and the relation these have with drought disasters.

Muhammad Masood

Research Assistant — *Bangladesh*

I am here for pursuing my Ph.D. degree in Disaster Management. I think ICHARM has a very good research environment with a group of research experts. I hope I will be able to enrich my knowledge to contribute to my country as Bangladesh is the most vulnerable for water related disasters and ICHARM is dealing with the same issue to reduce vulnerability.

Transfer (April 2012 - January 2013)

30 June	**ADIKARI Yoganath**（アディカリ・ヨガナス）
31 July	**CHAVOSHIAN Seyed Ali**（チャボシアン・セイエッド・アリ）
19 August	**Dinar ISTIYANTO**（ディナル・イスティアント）
30 September	**Amithirigala Widhanelage JAYAWARDENA**（ジャヤワルダナ・アミティリガラ）
30 December	**Akihiro SHIRATORI**（白鳥 昭浩）

Publication List

*October 2012 - January 2013.

Peer-reviewed Papers

- Badri Bhakta Shrestha, Hajime Nakagawa, Kenji Kawaike, Hao Zhang, *Glacila and sediment hazards in the Rolwaling valley, Nepal*, International Journal of Erosion Control Engineering, Japan Society of Erosion Control Engineering, December 2012
- 清水孝一, *衛星観測雨量を用いた海外における土砂災害の危険度評価に関する可能性*, CSIS DAYS 2012「全国共同利用研究発表大会」研究アブストラクト集,東京大学空間情報科学研究センター, 2012年11月
- 林真一郎, 水野正樹, 小山内信智, 西真佐人, 清水孝一, *ALOS(だいち)合成開口レーダーを用いた崩壊地抽出手法と適用性*, 砂防学会誌, 砂防学会, 2012年11月
- Ali Chavoshian, Shinji Egashira, *Special Issue on Flood Management and Flood Disaster Mitigation Measures*, Jornal of Disaster Research, Fuji Technology Press Co. Ltd, October 2012

Journal Papers

- 杉本めぐみ, *記憶と解放、記憶と伝承ーインドネシア・アチェの津波経験を踏まえてー*, 情報知識学会誌第22巻4号 p.355-364, 情報知識学会, 2012年11月
- 清水孝一, Badri Shrestha, 岡積敏雄, 小山内信智, 石塚忠範, *海外における広域土砂災害危険度推定の試みー衛星観測雨量情報を用いてー*, 日本災害情報学会 第14回研究発表大会予稿集, 日本災害情報学会, 2012年10月

Other Papers

- 杉本めぐみ, 生きる防災 *アチェの誓いー津波被害のインドネシアで調査・教育に奔走ー*, 日本経済新聞2012年12月25日, 32頁
- Daisuke Kuribayashi, *Report on 2011-2012 M.Sc. Program, "Water-related Disaster Management Course of Disaster Management Policy Program"*, Technical note of PWRI No.4251, PWRI, January 2013
- 栗林大輔, *2011-2012 修士課程「防災政策プログラム「水災害リスクマネジメントコース」実施報告書*, 土木研究所資料第4245号, 土木研究所, 2012年11月
- 深見和彦, 吉谷純一, 水文・水理現象に関する調査（特集：河川砂防技術基準調査編の改定）, 河川, No.794, 2012年9月

Oral Presentations (Other presentations)

- Megumi Sugimoto, Toshio Okazumi, *Early warning and early evacuation from tsunamis, floods, volcano and other hazards*, American Geophysical Union 2012 Fall meeting, December 2012
- 杉本めぐみ, *巨大津波後のアウターライズでの地震から露呈した津波防災の課題とまだ隠れている課題*, 巨大津波災害に関する合同研究集会, 2012年12月
- Narayan P. Gautam, *A study of ground-based, satellite-estimated and radar rainfall relationships at downstream of Shinano River, Japan*, JAXA and NASA, November 2012
- 牛山朋來, *2010年パキスタン洪水をもたらした豪雨のダウンスケール再現実験*, 日本気象学会2012年秋季大会, 日本気象学会, 2012年10月
- Shiro HISHINUMA, *Application of a Distributed Hydrological Model in the Karun River Basin, Iran*, IAHS PUB symposium 2012, IAHS, October 2012

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