

**ATTI DEL CONVEGNO**

***ITALY-CHINA: AN ANCIENT CULTURAL HERITAGE  
AND THE CHALLENGE FOR FUTURE DEVELOPMENT***

**Bologna - 22 - 23 Ottobre 2012**

**Università di Bologna-Dipartimento di Storia, Culture, Civiltà  
CNR-ISMAR di Bologna**

**a cura di**

**ADRIANA GALVANI**

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*Si ringraziano per la collaborazione:*

*Riccardo Pirazzoli*

*Alessandra Maccioni*





## ATTI DEL CONVEGNO

### *ITALY-CINA: AN ANCIENT CULTURAL HERITAGE AND THE CHALLENGE FOR FUTURE DEVELOPMENT*

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Questo volume contiene i contributi del convegno “Italy-Cina: An Ancient Cultural Heritage And The Challenge For Future Development”, svoltosi dal 22 al 23 Ottobre 2012, organizzato da Adriana Galvani dell’Università di Bologna-Dipartimento di Storia, Culture e Civiltà, con il sostegno di CNR – ISMAR Bologna. Una versione in formato elettronico di questo volume è stata precedentemente curata dal dottor Francesco Marabini del CNR.

Le conferenze sono state tenute sia presso il Dipartimento Universitario sia presso il CNR.

L’incontro ha rappresentato la continuazione di un progetto più che ventennale di collaborazione tra CNR - ISMAR e Accademia Cinese delle Scienze (CAS) – Istituto di Geologia Marina di Qingdao volto alla protezione delle coste e dei mari.

Il convegno ha avuto una connotazione transdisciplinare, basata su Scienze Umane e Geofisiche i cui contributi vengono qui descritti.

#### Scienze Umane

Galvani, con Pirazzoli, ha aperto la sezione umanistica del convegno presentando un’analisi dell’immagine della comunità cinese in Italia. Il diverso legame col luogo delinea: un cinese cosmopolita, che fonda la sua immagine sull’extraterritorialità e sa assimilarsi al luogo in cui risiede, oppure un cinese tradizionale, legato alla territorialità e meno integrato.

Galvani ha continuato con uno studio sulle modifiche del consumo alimentare in Cina: lo sviluppo economico provoca espansione urbanistica e crescita dei redditi, ma muta anche gli stili di vita dei cinesi, con conseguenze negative sulla salute.

Pirazzoli, con *Architettura per Nuovi Paesaggi* ha evidenziato come l’identità dei gruppi sociali sia leggibile attraverso i progetti architettonici realizzati da alcune comunità in Nepal, Cina, Grecia e Italia.

Marzia Marchi ha descritto le relazioni marittime Cina-Asia Sud Orientale fra XVI e XVIII secolo, con una focalizzazione sulla città di Hoi An, in Vietnam, oggi patrimonio dell’UNESCO e meta di turismo culturale. La città conserva la struttura urbana di quel periodo e documenta le relazioni fra le componenti etniche della popolazione.

Il prof. Fanfani assieme a due ricercatrici di statistica dell'Università di Bologna, Nica Calò e Peng Bin, ha presentato i dati relativi alle condizioni di vita della popolazione rurale dell'ultimo censimento completato in Cina nel 2006. Emergono indicatori socioeconomici che permettono di classificare le varie aree rurali e stabilire differenze regionali. In una seconda ricerca, lo stesso team ha invece illustrato gli indicatori delle performances economiche cinesi.

Lauretta Rubini dell'Università di Ferrara, ha presentato il Research and Learning Project del GRANT cinese. Ha analizzato i differenziali di prezzo nelle esportazioni di prodotti tradizionali italiani e cinesi, che soddisfano esigenze di consumo molto diverse e quindi Made in Italy e Made in China non sono concorrenti sul mercato.

Elisa Baroncini, ricercatrice dell'Università di Bologna, ha illustrato gli aspetti della controversia tra Cina e WTO sulle *Rare Earths*, che ha riportato alla ribalta il tema del rapporto tra restrizioni all'esportazione e preservazione delle risorse naturali e dell'ambiente. Infatti, la Cina, per limitare l'enorme inquinamento provocato dall'estrazione intensiva delle terre rare ha introdotto una normativa sull'esportazione di quelle materie prime.

Fumagalli, geografo di fama internazionale, ha analizzato il processo di sviluppo economico cinese, stabilendo un confronto con la situazione italiana. Come l'Italia anche la Cina deve confrontarsi con quella che è stata definita la "fatalità geografica" che condiziona le modalità del suo sviluppo. Tuttavia, lo sviluppo cinese ha modi e tempi di azione suoi propri e diversi dalle modalità occidentali, quindi per noi difficilmente comprensibili.

La cartografia ha avuto uno spazio rilevante all'interno del congresso, grazie a Galvani e Marabini che hanno analizzato antiche carte cinesi e il loro successivo processo di integrazione con la cartografia occidentale. La cartografia cinese perde le sue peculiarità e si europeizza con Matteo Ricci, che realizza per l'Imperatore una carta con la Cina al centro del mondo.

## Scienze Geofisiche

La dottoressa Ravaioli, direttrice di ISMAR Bologna, ha presentato le attività di ricerca dell'Istituto di Geologia Marina e, in collaborazione con i colleghi, ha riassunto l'attività dell'Environmental Group ISMAR-CNR di Bologna. Gli scienziati del CNR hanno ricavato modelli ambientali che schematizzano i processi di contaminazione. Gli studi hanno dimostrato la corrispondenza tra questi modelli e risultanze empiriche.

Ci sono prove che la composizione dell'acqua marina non è stata costante nel corso delle ere geologiche. Il dottor Ligi del CNR, ha discusso le sue ricerche basate sull'analisi di dati sulla concentrazione di

Mg e Ca, risalenti a milioni di anni fa e che permettono di prevedere i trend futuri delle variazioni chimiche dell'acqua marina.

In città il tasso di incidenza delle malattie è triplo rispetto alle aree rurali: le aree urbane sono ormai veri e propri canyon in cui si annida l'inquinamento e dove la temperatura media è più elevata rispetto alle campagne. Lo studio presentato da Rita Baraldi, direttrice dell'Istituto IBIMET del CNR, dimostra che inserendo nelle città alcuni tipi di piante si possono attenuare gli effetti negativi dell'inquinamento.

Prevati, dirigente dell'Ente di Gestione per i Parchi e la Biodiversità – Delta del Po, con Luciani, ha analizzato gli ambienti fluviali, in una ricerca sugli habitat costieri in cui sono presenti residue “*zone umide*” di pesca, acquacoltura e turismo che influiscono sull'ecosistema.

Il dottor Brunelli, esperto ambientale, ha proposto alcune soluzioni per il recupero dell'anguilla europea, specie oggi a rischio, ma di grande importanza sia biologica che economica. Il suo articolo si basa su ricerche svolte nella laguna di Comacchio e delinea un European Eel Management Plan nelle lagune costiere di tutto il Mediterraneo.

Il dottor Gasperini, esperto di protezione delle coste, ha descritto lo strumento galleggiante da lui ideato al CNR che consente con costi ridotti e software libero di rilevare dati in un contesto ambientale problematico come quello dei bassi fondali, in cui i fenomeni on e off shore si mescolano. In particolare, nella valle di Comacchio questo strumento ha evidenziato le interazioni tra fango e sedimenti e ha permesso di ricostruire la morfologia dell'area.

Il dottor Bortoluzzi ha illustrato il lavoro del team di ricerca: *The Northern Adriatic Sea: A Long-Term Ecological Research (Lter) Site*. Le coste adriatiche sono monitorate e analizzate attraverso le stazioni di Trieste, Venezia e alcune boe (di cui è stata spiegata la tecnologia utilizzata sopra e sotto la superficie dell'acqua) situate sotto il delta del Po, davanti a Rimini e a Senigallia.

Un team di geologi (Angeli, Gasparetto, Marabini, Mertzanis, Stanica e Pontoni) ha partecipato a ricerche, in collaborazione con la geografa Galvani: sulla morfologia del Mar Adriatico; sulle conseguenze dell'antropizzazione nelle sue coste; sui delta e estuari fluviali in Grecia e Italia; sull'impatto delle attività umane sul trasferimento dei sedimenti nei sistemi fluviali e nelle coste di Italia, Grecia e Romania.

Il geologo Paolo Ciavola ha presentato uno studio sugli effetti dell'erosione sull'isola fluviale di Sandwip in Bangladesh. Sono ricavabili modelli per analizzare e prevedere i trend e permettere quindi una tutela delle popolazioni attraverso sistemi di allarme e di gestione dell'emergenza.

Gli effetti negativi dell'antropizzazione sono evidenti anche nelle aree della costa Sud del Mare di Bohai, di cui tratta lo studio di Braga e altri. Il progetto EPHEUS, descritto nel paper, dovrà

monitorare gli effetti negativi sull'ecosistema costiero. Anche la laguna di Venezia presenta effetti derivanti dall'attività umana. In un ulteriore studio, Braga e colleghi analizzano la contaminazione salina paragonando l'ecosistema veneziano a quello della Laizhou Bay in Cina.

Marabini nei suoi studi, ha dimostrato come sviluppo e sfruttamento del territorio offrano guadagni immediati, ma sul medio/lungo periodo generino problemi costosi da risolvere. Infatti, attraverso una documentazione di foto attuali e di oltre 50 anni fa, Marabini ha evidenziato i danni di un'eccessiva cementificazione delle coste italiane. Il modello di sviluppo economico non dovrebbe prescindere dalla tutela dell'ambiente.

Allegato

Il lavoro di Dorothy I-Ru Chen è una lunga analisi dei processi evolutivi del sistema educativo di Taiwan che gode di fama mondiale. Il suo lavoro è posto in allegato sia per onorare la sua particolare preparazione didattica sia perché pur essendo di cultura cinese, appartiene politicamente a Taiwan.

## PARTE 1

### Contributi di Scienze Umanistiche

**Adriana Galvani\*, Riccardo Pirazzoli**

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#### **L'IMMAGINE DELLA COMUNITÀ CINESE: TRA COSMOPOLITISMO E TRADIZIONE**

Abstract: l'immagine della comunità cinese è più sfaccettata di quanto sia percepita. L'opposizione tra cultura moderna e tradizionale fa emergere l'importanza del rapporto con il luogo, non necessariamente fisico. Da questa opposizione emerge una subcontrarietà: assimilazione vs. coscienza etnica. Il legame col luogo delinea: il cinese cosmopolita, che costruisce la sua immagine sull'extraterritorialità e sa assimilarsi al luogo in cui risiede; il cinese tradizionale, legato alla territorialità e meno integrato.

Parole chiave: moderno/tradizionale, assimilazione, coscienza etnica, cosmopolitismo, territorialità

Contro un'immagine monolitica

Capire quale sia l'immagine di una comunità è importante perché una società è realizzabile solo se “gli individui che la compongono veicolano nella loro mente una specie di immagine di questa società” (Ma Mung, 1994, 202). La comunità cinese soffre oggi di un'immagine prevalentemente negativa. È considerata un monolitico “gruppo a sé stante, rivolto solo verso se stesso, e poco propenso a contatti esterni. I cinesi sono spesso considerati persone con cui, al di là di un rapporto formale, nessun'altra forma di relazione è possibile, perché il loro modo di rapportarsi verso chi non è cinese, è schivo ed introverso, fatto di poche parole e di sguardi veloci. Infine, il fatto che gran parte dei cinesi parli in modo stentato l'italiano, non aiuta la conversazione o qualsiasi contatto prolungato nel tempo, che non sia un mero scambio economico” (Bressan, 2011, 140). Il migrante cinese costruisce “molteplici relazioni – familiari, economiche, sociali e politiche – tra luoghi diversi promuovendo progetti di miglioramento delle condizioni di vita delle zone d'origine, mediante costanti e consistenti investimenti” (ibidem), e crea attività imprenditoriali nel paese di destinazione

che possono coinvolgere anche i luoghi di provenienza (cfr. Zanfrini, 2007; Ambrosini, 2005; Bianco, 1996).

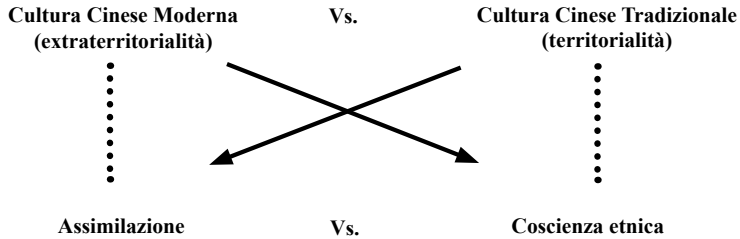
Secondo questa visione, la comunità cinese conserverebbe le proprie peculiarità in territorio straniero, nonostante viva “lo sradicamento dal territorio di origine, cioè l'impossibilità di riprodursi in uno spazio fisico chiuso, circoscritto e tangibile da cui essa tradizionalmente ha origine” (Ma Mung, 1994, 195). Dato un contesto simile, è allora lecito chiedersi come questa comunità possa mantenere un'immagine di così salda coesione “nonostante la distanza” (Ma Mung, 1994, 193). La sua cultura d'origine appartiene infatti a un passato collocato in un altrove, un lontano paese ormai straniero con costumi, rituali e comportamenti diversi da quelli del paese ospitante. Inoltre, nel nuovo qui, cioè nel territorio di residenza, la comunità, soprattutto attraverso le nuove generazioni, crea “processi di reinterpretazione e rigenerazione, attraverso il simbolico, l'immaginario, la nostalgia. Se molto si perde si acquista anche tanto, perché l'immigrato è un relativista culturale che emerge come soggetto sociale sia nelle realtà locali sia in quella internazionale” (Campani et al., 1994, 5).

L'immigrazione cinese in Italia si è caratterizzata, dagli anni '80, per il suo carattere familiare che, negli ultimi anni, attraverso ricongiungimenti, nuove unioni e nuove nascite, ha prodotto “una popolazione immigrata assai stratificata demograficamente, in cui convivono più generazioni, spesso con livelli molto diversi di acculturazione rispetto al contesto italiano” (Cologna, 2005, 1). Questa monolitica immagine potrebbe quindi essere uno stereotipo: l'emigrazione ha costretto a “concepire uno spazio immaginario, fantasticato, ricostruito su scala internazionale” (Ma Mung, 1994, 194) e ha forgiato “un nuovo tipo di identità cinese: quella del cinese cosmopolita” (Kwok Bun Chan, 1994, 210), che costruisce “una rappresentazione di sé nello spazio caratterizzata da una posizione di extraterritorialità” (Ma Mung, 1994, 194). Ne deriva un'immagine ben più articolata di quella comunemente percepita, in cui “la cultura cinese moderna [è] contrapposta alla cultura cinese tradizionale, l'assimilazione [è] contrapposta alla coscienza etnica” (Kwok Bun Chan, 1994, 210).

### Analisi d'immagine

In questo articolo, si analizzano le stratificazioni che compongono oggi l'immagine della comunità cinese attraverso il quadrato di Greimas (1966). Si parte da due semi fra loro opposti e per la precisione contrari, che in virtù della loro contrarietà costituiscono una sola categoria semica a due membri: moderna cultura cinese vs. tradizionale cultura cinese. Dal momento che “l'identità ha la necessità di collegarsi con uno spazio fisico, con un territorio” (Ma Mung, 1994, 196), si associerà questa opposizione ad una legata allo spazio: extraterritorialità vs. territorialità.

Ad entrambi i semi principali si applica l'operazione logica della negazione per generare il contraddittorio di ciascuno di essi. I lati verticali del quadrato sono caratterizzati da una relazione di presupposizione.



Moderna

Quando si emigra, “il mantenimento dell’identità attraverso l’identificazione carnale, fisica con la terra di origine non è più possibile” (Ma Mung, 1994, 199). I migranti assumono l’immagine di traslati, cioè di “individui impegnati in un continuo lavoro di trasferimento e di traduzione di linguaggi, culture, norme, legami sociali e simbolici, dove l’identità e l’appartenenza comunitaria viene forgiata non più da un senso di perdita, ma da un insieme di elementi tratti sia dal paese di origine che di insediamento” (Bressan, 2011, 139). Nei cinesi cosmopoliti, la “coscienza di sé in un non luogo” (Ma Mung, 1994, 197) fa sì che gli aspetti relativi al qui e altrove siano percepiti come dimensioni complementari di un unico spazio di esperienza (Blunt, 2007; Clifford, 1999; Vertovec, 1999, 2007; Portes et al, 1999). La tendenza a tenere assieme vecchie e nuove appartenenze e identità, determina una figura del migrante cinese come attore sociale ricco di iniziativa e promotore di mutamenti economici, culturali e sociali (cfr. Ambrosini, 2005; Zanfrini, 2007). A prova di ciò, secondo il Rapporto Caritas/Migrantes (2009), “il 53% degli appartenenti alla comunità cinese sente molto l’appartenenza all’Italia, percentuale che sale al 73% per coloro che esercitano un’attività imprenditoriale, mentre scende al 32% tra i disoccupati”.

Le seconde generazioni cinesi provocano un’integrazione sociale effettiva, “perché sono portatori di codici culturali, linguistici e comportamentali appartenenti a due mondi. È grazie a loro che la barriera socio-relazionale può essere ridotta” (Bressan, 2011, 150). La loro peculiare natura di cinesi cosmopoliti ha un effetto sulle loro relazioni: sono liberi di “disegnare reti, d’immaginare, di concepire relazioni che vanno al di là delle frontiere” (Ma Mung, 1994, 198). Emerge quindi una grande “spinta di apertura verso l’esterno: il reale desiderio di conoscere “l’altro” e di “farsi conoscere”, di non voler restringere il cerchio nei consueti rapporti tra connazionali. Al contrario,



molti di loro cercano di intessere amicizie con altri giovani italiani, nonostante le distanze linguistiche e culturali siano riconosciute come grossi ostacoli alla creazione di un rapporto” (Bressan, 2011, 150).

## Tradizione

La mancanza di legame col territorio propria del migrante può portare però “verso l’identificazione con l’entità comunità-etnia” (Ma Mung, 1994, 198). La cultura tradizionale compensa l’impossibile attaccamento al territorio di origine, ormai perduto, con “l’empatia verso i simili umani” (ibidem). Per questo motivo, per ogni migrante è fondamentale il capitale sociale (cfr. Bourdieu 1980, 1985), ovvero l’insieme dei “legami diretti ed indiretti di cui lui dispone e, tali legami, caratterizzano la sua rete sociale; e nel momento in cui egli emigra, questi contatti si mischiano a quelli degli altri migranti che, come lui, fanno parte del network migratorio” (Bressan, 2011, 153). Il capitale sociale è componente della rete etnica, cioè della rete di chi condivide una comune origine nazionale, con cui si possono aiutare i connazionali e che permette l’incontro di migranti reali e migranti potenziali in un continuo avvicinarsi di relazioni (cfr. Portes, 1998). La costruzione di reti etniche che “si appoggiano su persone identificate come simili per stabilire relazioni” (Ma Mung, 1994, 199) influenza “gli obiettivi degli individui, i mezzi da loro scelti nel definire i limiti della loro stessa azione” (Bressan, 2011, 153). A testimonianza di ciò, basti pensare che, dopo oltre vent’anni di emigrazione dalla Cina all’Italia, “l’accesso degli immigrati cinesi ai servizi sanitari resta riservato primariamente a coloro che parlano l’italiano (anche a livello elementare) o che possono impiegare i propri figli o parenti come interpreti” (Cologna, 2005, 1).

## La coscienza etnica

Analizzando il seme cultura tradizionale è emerso come il legame col territorio sia sostituito dalla rete etnica. Ciò genera “allontanamento e diffidenza nei confronti di colui che è al di fuori della comunità” (Ma Mung, 1994, 199). Tuttavia, l’identità “ha la necessità di collegarsi con uno spazio fisico, con un territorio” (ibidem): chi è emigrato sa che “il suo territorio non è in un luogo preciso, ma in una molteplicità di luoghi che si equivalgono poiché nessuno è il luogo insostituibile dell’identità”. Questa consapevolezza può portare al cosmopolitismo, ma anche alla chiusura: lo sradicamento dal territorio di origine stimola il concepimento di uno spazio immaginario, fantasticato, un territorio

ideale perché, si crede, è quello in cui si radica la propria coscienza etnica. Quest'ultima è stata finora la vera forza di ciascun migrante cinese: "è la rete etnica a cui appartiene e, in particolare, la famiglia estesa di cui è membro che rappresenta il suo capitale sociale più importante, da cui egli riceve tutto l'appoggio necessario per realizzare il suo progetto migratorio e che, rispondendo alle varie esigenze, riesce a trovare i soldi necessari per concretizzare questo progetto" (Bressan, 2011, 155).

Questa comunità è composta soprattutto da adulti cinesi "inseriti nell'economia d'enclave, ovvero che lavorano all'interno di imprese gestite da cinesi, con colleghi cinesi, senza alcuna seria prospettiva di riuscire ad abbassare la barriera linguistica e costretti perciò a interagire con la società locale per mezzo di intermediari. Quando questi ultimi non sono loro familiari, si tratta quasi sempre di connazionali che prestano tale servizio a pagamento e con dubbia competenza"(Cologna, 2005, 2).

### Assimilazione

Questo seme è in rapporto di complementarità con la cultura moderna che, essendo cosmopolita, presuppone l'assimilazione nella comunità ospitante. Lo dimostra il fatto che "all'interno della popolazione cinese di Milano esistono quote sempre più rilevanti di persone bene integrate, che parlano correntemente l'italiano e che non hanno problemi a rapportarsi con i servizi" (Cologna, 2005, 2).

Occorre sottolineare che nel quadrato di Greimas (cfr. 1970), i due semi in basso, chiamati subcontrari, sono fra loro meno nettamente opposti di quanto non siano i due contrari originari. È quindi possibile individuare un termine neutro che combini i due subcontrari, che si possono fondere. Per esempio, bianco e nero hanno come subcontrario grigio, che infatti non è né bianco né nero. Nel caso dell'immagine della comunità cinese, assimilazione e coscienza etnica possono convivere: i giovani vivono consapevolmente la loro "doppia identità come una fortuna sul piano lavorativo e un arricchimento sul piano personale. I giovani cinesi, rispetto agli adulti, affermano più apertamente che il sentirsi "italiano" non toglie nulla al sentirsi "cinese" (Bressan, 2011, 151).

Gli esempi di assimilazione sono stati già registrati: "dalle interviste effettuate a migranti cinesi residenti in Trentino Alto Adige, si è appreso che alcune famiglie cinesi condividono con altre, italiane o tedesche, momenti di svago come lo sciare assieme, il passeggiare in montagna o l'uscire in pizzeria. In provincia di Trento, dove le famiglie di cinesi lavorano nella lavorazione del porfido oppure emigrano in Veneto per essere impiegati nell'abbigliamento, sono nati dei bei rapporti tra famiglie italiane e cinesi. Alcune famiglie italiane, infatti, hanno letteralmente "adottato" le seconde, aiutandole nei momenti di bisogno: le mamme italiane portano dal dentista o dal pediatra, per esempio,

oltre che il proprio figlio anche il figlio della famiglia cinese con cui hanno un rapporto più stretto; oppure si agevolano nello scambio di vestiti” (ibidem).

## Conclusioni

La comunità di migranti “è una nuova forma sociale, espressione delle nuove forme di rapporti che la società mantiene con lo spazio. E questi rapporti annunciano forse la fine dei territori” (Ma Mung, 1994, 202). Dall’analisi svolta, infatti affiora un’immagine della comunità cinese fondata sul legame con luoghi immaginari, non fisici: l’immagine moderna è costruita sull’extraterritorialità, ovvero sulla consapevolezza che “la casa non deve trovarsi in un luogo determinato ma, almeno provvisoriamente, può essere dovunque” (Kwok Bun Chan, 1994, 229); l’immagine tradizionale è basata su una territorialità mitica che ricostruisce la propria specificità etnica. Per quanto questi luoghi fondativi siano non concreti, è emersa la conferma di come “la coscienza di un posto sia strettamente collegata alla coscienza di sé, per afferrare la propria posizione in un più ampio schema di cose, inclusa la propria comunità, e per assicurarsi un sicuro senso di chi è considerabile come individuo” (Basso, 1996, 5; trad. mia).

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**Riccardo Pirazzoli**  
**ARCHITETTURA PER NUOVI PAESAGGI**

*“Il paesaggio è ciò che si vede dopo aver smesso di osservarlo.”*

Gillés Clément

Abstract: si analizzeranno i Programmi Narrativi di vari progetti architettonici (in Nepal, Cina, Grecia e Italia) che hanno modificato il paesaggio. Il Programma Narrativo è la promessa di ciò che si può fare con esso, e rende un luogo fondativo dell'identità di un gruppo sociale. Se il Programma Narrativo del paesaggio si riduce a immagine stereotipata da consumare, si costruisce *junkspace*, privo di relazione, identità e storia, non turisticamente attraente.

Parole chiave: paesaggio, programma narrativo, *junkspace*

#### Semiotica del paesaggio

Nella Convenzione Europea del Paesaggio del Consiglio d'Europa, il paesaggio “designa una determinata parte di territorio, così come è percepita dalle popolazioni, il cui carattere deriva dall'azione di fattori naturali e/o umani e dalle loro interrelazioni” (CEP, 2000, art. 1a). Soprattutto in Italia, esso è considerato “umanizzato, non soltanto per quello che riguarda il forte rapporto tra l'ambiente e la cultura, o tra la pittura e la cultura in generale, ma per il legame particolare tra la rappresentazione del paesaggio e il paesaggio stesso” (Ghirri, 2010, 107). Analizzare sia i paesaggi “eccezionali che i paesaggi della vita quotidiana e i paesaggi degradati” (CEP, 2000, art. 2) come se fossero *oggetti culturali* “in cui si trovano iscritti la strategia per renderli appetibili in senso commerciale [...], ma anche le istruzioni per il buon uso e le azioni potenziali che, per mezzo di essi, si possono compiere” (Pozzato, 2002: 287-288), permette di esplicitare come “la forma, la materia e le proporzioni dell'oggetto preannunciano il rapporto che esso avrà con il corpo di chi lo userà” (*ibidem*). La funzione di un oggetto (*cf*: Floch, 1992) e la molteplicità dei suoi significati aggiunti sono analizzabili in termini di Programmi Narrativi (Pozzato, 2002, 289; d'ora in poi PN), cioè l'insieme di azioni possibili di soggetti (turisti e abitanti del luogo) che, con l'aiuto dell'oggetto in uso (il paesaggio), fanno cose nel mondo per raggiungere scopi. Analizzare il paesaggio in termini semiotici consente di “astrarlo dalla sua oggettività referenziale e prendere in considerazione quelle pratiche di enunciazione che ne fanno un testo progettato per essere significativo” (Pozzato, 2002, 288). Infatti, l'interpretazione di un paesaggio “emerge da interpretazioni condivise all'interno di unità culturali e sociali. Queste però non sono né date a priori, né immutabili,

né prive di contrasti tra loro e internamente” (Sassatelli, 2005, 61). Applicando strumenti semiotici, sono quindi determinabili due componenti che rendono significativo un paesaggio:

✓ La funzione, il significato letterale dell’oggetto, cioè l’insieme di azioni possibili che con quell’oggetto si devono/possono compiere. Un paesaggio “è un’entità spaziale composta da parecchi elementi [...]. Secondo il luogo, vi sono fattori naturali più o meno numerosi contenuti in un sito” (Lozato-Giotart, 1999: 60): la scelta di valorizzare alcuni di questi fattori naturali, le sue “potenzialità turistiche teoriche” (Lozato-Giotart, 1999: 61), a scapito di altri, preannuncia l’uso che un potenziale turista potrà farne.

✓ All’oggetto si aggiungono significati ulteriori che sono valorizzati per aggiungere un surplus di desiderabilità e/o per indurre ad acquistarlo (cfr. Pozzato, 2002). Questi sono legati alle capacità richieste per interpretare gli stimoli offerti dal paesaggio quando ci confrontiamo con esso: “i linguaggi che capiamo, scriviamo o parliamo, i nostri livelli di alfabetizzazione in rapporto ad altre forme simboliche” (Hannerz, 2001, 29).

## Architettura e paesaggi

Analizzando i PN di alcuni paesaggi, si dimostrerà che le architetture capaci di applicare “regole consolidate della bellezza” (Romano, 2008, 13), non solo non diventano rapidamente obsolete, ma valorizzano il luogo che modificano. Esse producono PN condivisi e consumati dalla comunità che vive quel luogo, senza generare *junkspace*, ma paesaggi identitari, storici e relazionali, appetibili anche per il turismo.

Si analizzeranno i PN di alcuni paesaggi situati in paesi diversi:

In Nepal, dove l’architettura tradizionale è ben conservata e ci sono aree ancora incontaminate.

In Cina, dove la forte urbanizzazione convive con progetti di recupero dell’architettura tradizione.

In Europa (Grecia e Italia), dove si deve gestire l’architettura storica, parte integrante dell’identità comunitaria.

Lo studio si baserà su tre indicazioni (cfr: CEP, 2000):

- ✓ il paesaggio deve essere considerato come insieme
- ✓ il paesaggio ha un valore diffuso e quotidiano
- ✓ non basta la mera conservazione, ma occorrono misure di salvaguardia, gestione e pianificazione.

Dhulikel: non costruire

Se l'oggetto è un "luogo di accoglimento dei valori che il Soggetto vi investe" (Pozzato, 2002: 44), allora anche il paesaggio è considerabile tale: con l'esplosione del turismo di massa, i luoghi sono "sempre più modificati o organizzati per e, talvolta, dai turisti [...]. Lo spazio non è più solamente visitato: è organizzato (rimodellato, ristrutturato) e anche consumato" (Lozato-Giotart, 1999: 20). Il turismo produce e consuma paesaggi che sono "profondamente organizzati per essere meglio visitati" (*ibidem*). Il paesaggio, prodotto di tempo (storia, cultura, architettura, tradizioni) e spazio (natura, collocazione geografica, radicamento a un territorio), è "un'immagine riassuntiva del recettore per il turista" (Lozato-Giotart, 1999: 60-61; corsivo mio). A Dhulikel però non sono visibili modifiche: la veduta sull'Himalaya è rimasta identica negli ultimi anni (vd. Fantin, 1971). Le coltivazioni a terrazza sono l'unico intervento antropico visibile. Il valore del PN di questo paesaggio (la sua qualità) nella sua globalità non è né "misurabile" né "in se stesso indiscutibile" (cfr. Koolhaas, 2006), infatti:

- ✓ non ha funzione pratica, è consumabile dai turisti solo tramite la contemplazione
- ✓ per la comunità autoctona, esso è "un patrimonio identitario che non è mero lascito del passato, ma un valore continuamente costruito dalla volontà di chi abita e usa il territorio" (Clementi, 2002, 18).

Una possibile formula per valutarlo (Tempesta&Thiene, 2006: 25-26):

$Q_p = f(X; I)$  dove ( $Q_p$  = qualità paesaggistica;  $X$  = set dei descrittori del paesaggio;  $I$  = set delle caratteristiche individuali)

evidenzia che l'edificazione ne scalfirebbe la qualità, pur ad una minima capacità di carico, cioè "il massimo numero di persone che possono usare un luogo senza un'inaccettabile alterazione dell'ambiente fisico e senza un irreversibile declino nella qualità dell'esperienza conseguita dai visitatori" (Mathieson, Wall, 1987; *cit. in* Galvani, 2004, 15).



I danni arrecati da eventuali costruzioni all'integrità di questo paesaggio, ridurrebbero "l'attrattività turistica" (Galvani, 2004: 5), in quanto l'escursione a Dhulikel è venduta ai turisti perché da lì si può vedere il tramonto sull'Himalaya.

## Namahbuddha: manutenzione della tradizione

Il monastero buddista vive una eterna giovinezza perché la manutenzione è perenne. Le tecnologie che lo rinnovano sono cambiate, ma il suo PN è immutato. Finora, la scarsa accessibilità del luogo lo ha preservato e non si è costruito nessun edificio moderno per accogliere i turisti. La gestione di questo paesaggio pare sostenibile perché ne evita la banalizzazione provocata “dalla massa in costante crescita di turisti, una valanga che, alla ricerca perpetua del carattere, macina



identità di successo fino a ridurle in polvere senza significato” (Koolhaas, 2006, 100): il consumo eccessivo di un paesaggio conduce a “esperienze percettive di fatto già vissute nell’immaginario e veicolate dai media [...] per cui più che vedere posti nuovi, noi riconosciamo quelli che in effetti ci aspettavamo” (Sassatelli, 2005, 60). Nessuna massa di turisti finora ha invaso Namahbuddha e la comunità agricola che vive attorno al monastero mantiene intatte le sue abitudini,

così come i pellegrini che arrivano qui per pregare nell’antico stupa sorto dove la vita di Buddha fu risparmiata da una tigre. Il luogo resta incantevole, non è ridotto a immagine: al turista non è impedito “di vedervi un luogo, di ritrovarvi pienamente” (Augé, 2009, 81) e può godersi la vista sulla catena himalayana in una atmosfera autentica.

## Shanghai, Tianzifang District: convivenza di vecchio e nuovo

Diversamente dal Nepal, a Shanghai si può osservare l’architettura più moderna del mondo in quanto “la zona economica di Shanghai è la più grande entità di pianificazione subnazionale del mondo” (Davis, 2006, 14). Diversamente dalle tradizionali città occidentali, progettate per evitare “stridore architettonico” (Ghirri, 2010, 54) e dialogare col paesaggio circostante (cfr. Romano, 2008), le moderne periferie affermano “la morte della pianificazione urbanistica” (Koolhaas, 2006, 42): gli abitanti delle “strutture post urbane che stanno emergendo nell’Asia Orientale” (Davis, 2006, 14) sono privi “di un adeguato riconoscimento simbolico della loro appartenenza all’*urbs* e per questo a pieno titolo alla *civitas*” (Romano, 2008, 107). Questa appartenenza alla *civitas*, dall’anno 1000 in poi, caratterizzava la società europea, “nella quale l’affiliazione a un clan è diventata secondaria e le persone appartengono prima di tutto a una città” (ivi, 10).

Nella città prodotta secondo i PN tradizionali, le famiglie “abitano ciascuna nella propria casa,



case accomunate dalla loro contiguità fisica, che presentano lungo le strade facciate la cui decorazione esteriore mostra l'evidente intenzione di volerle belle" (*ivi*, 13).

I paesaggi si caratterizzavano quindi come *oggetto culturale*, ovvero "significato condiviso incorporato in una forma" (Griswold, 1997, 26).

Quando la città diventa non identitaria, non storica e non relazionale, allora "l'ideale è la densità nell'isolamento" (Koolhaas, 2006, 39). Nella



fig. 4, domina infatti lo *junkspace* ovvero "il prodotto dell'incontro tra la scala mobile e l'aria condizionata, concepito in un'incubatrice di cartongesso" (*ivi*, 64), costruito solo per essere consumato, ma che "rende incerto su dove sei, rende poco chiaro dove stai andando, distruggendo il luogo dove eri" (Koolhaas, 2006, 82). Lo *Junkspace* riduce la città "a un congegno meccanico, chiamato soltanto a dimostrarsi efficiente rispetto a obiettivi misurabili e in se stessi indiscutibili" (*ibidem*).

Questo nuovo tipo di insediamento umano è dotato di scuole e ospedali, i cosiddetti servizi, ma è privo di "quell'universo simbolico che incorpora nella pretesa di eternità della sua irriducibile bellezza, il riconoscimento della *civitas* intera per l'identità e per la dignità individuale di ogni singolo cittadino" (Romano, 2008, 108). Il PN dello spazio-città concepito come efficiente congegno meccanico da consumare, si piega quindi alle esigenze della sfera tecnica, "ma poiché queste esigenze verranno rese obsolete dal progresso stesso della tecnica, progettare per rispondere a specifiche funzioni sarà tragicamente insensato, perché queste funzioni saranno per forza di cose labili" (*ibidem*). La nuova architettura invecchia precocemente e deturpa il paesaggio perché produce spazio con una sola funzione, ovvero un solo PN: "trasporto, transito, commercio, tempo libero" (Augé, 2009, 87). Progettare *Junkspace* significa disegnare un luogo privo di valore antropologico, estetico e storico: "abbiamo costruito più di tutte le precedenti generazioni messe insieme, ma per qualche ragione non possiamo essere misurati sulla stessa scala. Non lasciamo piramidi" (*ibidem*). A livello estetico, "ci muoviamo all'interno di un disastro visivo colossale. I segni si moltiplicano, sono in conflitto tra loro" (Ghirri, 2010, 54), in quanto manca una visione che determini i criteri con cui progettare efficaci PN per i paesaggi: "i ponti uniscono sponde spesso trascurabili, come versioni grottescamente ingigantite di un'arpa. A ogni ruscello il suo Calatrava" (Koolhaas, 2006, 95). Lo spazio moderno ha un'unica funzione abnorme che ne racchiude tutto il senso: il suo PN si definisce solo "attraverso le modalità d'uso" (Augé, 2009, 88).



A Shanghai anche il patrimonio storico sta però acquisendo valore.

Il quartiere Tianzifang, parte della ex concessione francese della città, è caratterizzato dalla tipica architettura Shikumen a mattoni grigi. Nel 2006 Tianzifang era stato destinato alla demolizione e all'ennesima produzione di *junkspace*. Il senso di *civitas* e di appartenenza al luogo degli abitanti del quartiere si è espresso attraverso

l'opposizione alla demolizione e con un efficace "low budget requalification management" che ha recuperato i deteriorati palazzi storici (cfr. Zheng Shiling, 2012). I cittadini hanno attivamente contribuito alla produzione del nuovo PN di Tianzifang, dimostrando che l'uso di un paesaggio non può essere prestabilito dall'alto, ma deve emergere "dal basso, attraverso la partecipazione della società civile nell'individuazione dei paesaggi e delle relative politiche" (Sassatelli, 2005, 67). Con questa opera di riqualificazione, si è enfatizzato il concetto di "qualità della vita a livello diffuso, sul valore quotidiano, apprezzato per il tipo di esperienza che rende possibile" (*ibidem*). Ora Tianzifang è infatti frequentato anche dai turisti in quanto labirinto culturalmente attraente (nei vicoli sono stati aperti gallerie e negozi d'arte), in cui si è recuperata un'atmosfera affascinante, mischiando "local and creative" (Zheng Shiling, 2012).

Tongli: riscoprire il passato

Le autorità pubbliche competenti hanno applicato strategie finalizzate a salvaguardare, gestire e pianificare il paesaggio di un comprensorio costituito da 7 isole, 15 fiumi e 5 laghi (Tongli, Jiuli, Yeze, Nanxing e Pangshan), per una superficie totale 63 kmq, ripartita tra 33.000 abitanti. Anche



in questo caso, l'obiettivo di qualità paesaggistica è stato conseguito recuperando la vecchia architettura, usando materiali tradizionali, e demolendo lo *junkspace* delle strutture fatiscenti di epoca maoista. Oggi il millenario villaggio è considerato una Venezia Orientale: vi si respira un'atmosfera autentica, pur essendo ricostruito e "negli ultimi anni è divenuto meta fortemente turistica, inserito in quasi tutti i tour. Numerosi i riconoscimenti ottenuti: nel 1982 è stato



incluso nella lista dei siti protetti (unico nella regione del Jiangsu); nel 1995 è incluso della prima lista di siti storici e culturali della regione; dal 2000 uno dei suoi giardini, il Tuisi, figura nella lista del patrimonio culturale mondiale. Inoltre, dal 1999, la China Film Association l'ha nominata set per la produzione di film e fiction televisive” (Flamminio, 2007).

### Santorini: ricostruire il passato

L'isola è tra le più famose della Grecia, tanto da essere usata come “un pretesto pubblicitario” (JP LG, 1999: 59): Santorini può essere infatti citata (cfr. Echtner & Ritchie 2003), tra i luoghi “repertoriati, classificati e promossi a luoghi della memoria” (Augé, 2009, 77) per essere resi vendibili, ma dove “non c'è nulla da conoscere. Si conosce già tutto quanto c'è da conoscere” (Augé, 2009, 54).

Sull'isola, alcuni spazi funzionano effettivamente solo come “punti di transito e occupazioni provvisorie (le catene alberghiere [...], i club vacanza [...])” (Augé, 2009, 77) che gli utenti/turisti consumano. Per quanto quindi ci sia un elevato sfruttamento turistico, Santorini pare un piacevole compromesso tra le esigenze di edilizia turistica e la conservazione del paesaggio.

Infatti, dopo l'ultima distruttiva eruzione del 1956, molti villaggi sono stati ricostruiti recuperando (se possibile) o copiando le bianche strutture architettoniche tradizionali, che dialogano perfettamente con il paesaggio nero del vulcano e il blu del mare. Il consumo turistico ha sicuramente modificato il PN associato al luogo: da “isola di pescatori e agricoltori” si è trasformato in “luogo di vacanza”. Il recupero delle architetture tradizionali, però, ha contribuito alla creazione di un'immagine turisticamente vendibile, evitando la costruzione di *junkspace* non identitario e privo di storia, perché “qualsiasi modifica del sito naturale originario, sia per sviluppi edilizi che per lavori pubblici, condurrà nello stesso tempo al consumo dello spazio e al suo snaturamento turistico” (JP LG, 1999: 61).

### Venzone: salvare il futuro recuperando il passato

Oggi, “i luoghi sono pervasi e modellati in misura crescente da influenze sociali relativamente distanti da essi [...]. L'avvento della modernità separa lo spazio dal luogo favorendo i rapporti tra persone assenti” (Giddens, 1994, 29-30). A Venzone, invece, i cittadini hanno deciso come progettare il luogo in cui vivono, confermando quanto scritto nel preambolo della CEP: “il paesaggio contribuisce

alla formazione delle culture locali”. Per una comunità, la produzione del paesaggio (*place-making*) ha sempre significato inventare nuovi PN, ovvero nuovi modi di consumare uno spazio: “ciò che la gente fa di un posto è connesso a ciò che fa di sé stessa” (Basso, 1996, 7; trad. mia). Il *place-making* sarebbe quindi “un modo per costruire identità personali e sociali. Siamo il luogo che immaginiamo” (*ibidem*). Si producono PN di un luogo per creare nuovi significati, in quanto il *place-making* “è un modo per costruire tradizioni sociali e identità personali e collettive” (*ibidem*).



Dopo il devastante terremoto del 1976, si è realizzato un restauro per *anastilosi*: sono state recuperate e numerate le pietre della costruzione distrutta, integrandole con nuovi materiali affini.

Il PN recuperato è identico a quello precedente il sisma: le strade sono state ricostruite storte come prima, senza rispettare gli efficienti parametri della modernità che non corrispondono alle esigenze della comunità. Nelle new town le strade sono dritte, ci sono villette a schiera circondate da un “prato insignificante con qualche panchina ombreggiata da un ciuffo di alberi” (Romano, 2008, 36): il risultato di questa “collisione tra rurale e urbano [...] è un paesaggio ermafrodito, una campagna parzialmente urbanizzata” (Davis, 2006, 17). A Venzone invece la funzione civica è stata recuperata totalmente, senza ridurre la città in congegno meccanico e si è anche salvata l’eredità storica del paese, salvaguardandone l’identità e rendendolo vendibile ai turisti.

## Conclusioni

Il paesaggio, che “costituisce per il turismo una risorsa primaria” (Galvani, 2004: 5), è un oggetto che combina un elemento fisico (la collocazione spaziale) a “una interpretazione di quel luogo e territorio in quanto paesaggio” (Sassatelli, 2005, 60). Esso è “un fenomeno culturale centrale per la formazione dell’identità e per la qualità della vita delle persone” (*ivi*, 54), ma la produzione di spazi dotati di una sola funzione, senza considerare le esigenze di chi vive quel luogo, genera spazi non identitari che devono solo essere consumati. Ciò impoverisce il PN di questi luoghi, ovvero il modo in cui si può vivere e agire in essi. Il turismo rischia quindi di provocare “una trasformazione del territorio, ignorando identità locali e valori naturali e trasformando il tessuto economico di base verso la ricerca del reddito a brevissimo termine” (Galvani, 2004: 4). L’esito di questa trasformazione è lo *junkspace*: le architetture che modificheranno il paesaggio, “lungi dall’esser fatte di vetro e

acciaio [...] saranno in gran parte costruite di mattoni grezzi, paglia, plastica riciclata, blocchi di cemento e materiali di recupero” (Davis, 2006, 24). L’abitante delle architetture future “vivrà nello squallore, circondato da inquinamento, escrementi e sfacelo” (*ibidem*)?

Non è un destino ineludibile. I casi proposti di produzione del paesaggio, o *place-making*, dimostrano che si può costruire un paesaggio identitario, storico e relazionale dotato di un PN rispettoso dell’identità antropologica del luogo: questa enfasi sulla dimensione intersoggettiva del paesaggio “induce a trattare [...] i modi in cui i processi di identificazione e di appartenenza fanno diventare patrimonio condiviso l’ambiente di vita quotidiano. Perché il paesaggio acquisti lo statuto di patrimonio deve infatti generarsi un senso comune che venga sentito come proprio dai diversi soggetti che agiscono al suo interno” (Clementi, 2002, 18), quindi anche dai turisti, in quanto “un patrimonio naturale e culturale intatto e valorizzato è una risorsa basilare per il turismo” (Galvani, 2004: 5).

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**NUTRITIONAL TRANSITION IN CHINA**

*In developed economies, being overweight is a health problem connected to many illnesses.*

*In underdeveloped economies, being underweight is a health problem.*

Chen, Gotway, 2012

The high rate of Chinese GDP increase is largely known. Many consequences derive from rapid changes in economy. These changes affect society at large and personal wellbeing too.

Tab. 1 - Country statistical profile: China 2011-2012

Production and income	Unit	2003	2004	2005	2006	2007	2008	2009	2010
Gross domestic product (GDP)	Bln USD curr. PPPs	4 157.8	4 697.9	5 364.3	6 242.4	7 338.7	8 219.0	9 057.4	10 085.7
GDP per capita	USD current PPPs	3 217	3 614	4 102	4 749	5 554	6 189	6 786	7 519
Gross national income (GNI) per capita	USD current PPPs	..	3 608	4 121	4 776	5 595	6 232	..	..
Real GDP growth	Annual growth %	10.0	10.1	11.3	12.7	14.2	9.6	9.2	10.3

Source: OECD /Country statistical profile: China 2011-12.

The effects of a flourishing economy which doubled its production in Asian regions have influenced and produced rapid changes in behaviors and life styles. New habits are more similar to the western practices with positive results on market and education, but often negative results on health.

First of all some social adjustments derive from internal modifications, such as the demographic policy on family planning which puts the Chinese families in the same conditions as the Western ones. Second, the phenomenon of globalization is quite a revolution for a closed State as China has been for several years. Third, the industrialization itself is a driver of modernization, as it has been

before for Japan and will be for other developing countries. Industrialization will also drive huge fluxes of migration from countryside towards cities, involving new ways of facing the modernization process. This process is otherwise affecting the basic health of people, first of all with the pollution caused not only by the chemical industrial effluents, but by the increasing number of cars, particularly crowded in major cities.

Among the many aspects of the economic evolution we will consider the nutrition transition, since the developed world is facing emerging challenges posed by consumerism's habits assumed along decades of booming economy.

After the WW Two, people have generally enjoyed a diversified alimentation, enriched by animal protein, but consumes exceeding needs have negatively affected the health of rich countries population. The rising costs of medicines and hospitalization, the great diffusion of certain diseases are suggesting to revise food intake. Dietary shifts are underway, as a result of increasing health awareness and concerns with obesity.

### Population and food production

The global population, which will reach 9.1 billion by 2050, with an increase of 120% in the developing world (FAO 2012) would force us to limit food consumes. Rural migration and urban population would put pressure on goods, since processed food needs more quantity and cause more waste than home produced food.

FAO estimates that agricultural production will need to increase by 60% globally and nearly 77% in developing countries by 2050 to cope with large and wealthier population.... To raise 3070 Kcal per person translates into additional consumption of 940 million tons of cereals and 200 million tons of meat a year by 2050, compared with 2005/7 production levels".

In China and India, crop production is expected to growth by more than 50% between 2000 and 2030 and 10% to 20% between 2030-2050. The counterpart is an unacceptable increase in pollution, since the agricultural sector emits around 14% of the total anthropogenic greenhouse gas emissions (IPCC, 2007), being the largest sectorial contribution after energy industry and deforestation.

Meat production has grown about 300% in the past 50 years and is anticipated to be one of the fastest growing commodities, due largely to growing incomes and the westernization of diets in many emerging economies. At the same time, the livestock capital has grown by 40% for porcine animals highlighting the role of China (FAO, 2012, p. 171).

A new trend is the increase of dairy products in developing countries, especially in the new emerging middle classes of India and China, where an increase of milk production is predicted at around 70%. Yoghurt is one of the new icons of emerging consumes, facilitated by multinational companies which influence consumers of retail chains. Even if milk products have started to increase one decade ago, they are one of the fastest growing sectors, requesting high quantity of work and land resources. They were stigmatized as the most environmental damaging consumes by the Club of Rome since the Sixties, when China hadn't known at that time these goods. The results of the investigations made by the Club's members stated that to nourish every cow it is necessary a dimension of land able to satisfy 100 person, if they were alimented with grass, but cow meat can nourish only 10 people. China is the second meat importer after Japan and is the second pig-meat producer and consumer.

This new trend is reversing the rice consumption in China, the opposite of the rice increase in developed countries. The grain consumes will remain high, but with a major influence of imported good to satisfy the demand, since per capita consumption remains high in comparison to world standards. If meat and dairy milk products are new for emerging countries, fish will continue to be a central element in food production, especially aquaculture fishery. Asian countries will dominate aquaculture production with a share of 89% in 2021, and China alone, presents 61% of total production. Consumption is expected to reach world per capita fish food of 19.6 kg in 2021, from the average of 18,5% in 2009-11. Global experts of fish and fishery products set a new record in 2011, reaching a value over US\$ 126 billion, 16% more than in 2010 (FAO; 2012).

Urbanization and income are originating a huge demand for prepared and preserved form of fish fillets, causing residual production used in fish meal manufacturing, with a general increase of both products consumption.

## Import-Export

With its large population, China has a small 0.1 ha of arable land per capita. Since then, arable land continues to shrink in China, from 130 million ha in 1996 to 121.8 million ha in 2006. A strict farmland protection policy has been implemented. Land for new agricultural uses is strictly controlled and a "red line" on arable land of 120 million ha has been set. China started to be a net food importer in the mid 2000s accounting for 3% share in export and 4,3% in import by 2007 (OECD, 2009).

One reason is the low per capita productivity, since the share in employment in agriculture is too high comparatively to the output, at 40.8% in 2007 with a contribution to GDP of 11.3,



including forestry and fishery, causing a rural-urban income gap of 3.3 per head in 2007 (OECD, 2009). The share of food in total living expenditure increased to 38% after food prices booming since 2007.

China acceded to WTO in 2001, to ASEAN in 2003 in order to manage the agricultural output. The ASEAN-China Free Trade Area (ACFTA) is set for ten years. The APTA Asia-Pacific Trade Agreement covers the oceans' countries, meanwhile the bilateral FTAs have been opened with: Chile in 2005, Pakistan in 2006, New Zealand in 2008, Australia, Iceland, Peru, Singapore, Arab States, India, Korea in 2008.

The main goal of the 11<sup>th</sup> Five Years Plan (2006-2010) was to reach food security, through 95% self-sufficiency in grain production, also doubling rural households income by 2020.

The four steps of the Plan included:

Improved food safety

Improved environmental protection

Improved agricultural competitiveness

Improved social and technical infrastructures in rural areas.

Grain security remains the top priority for the government, which implemented a strict farmland protection policy. Nevertheless China experiments the largest use of fertilizers in the world with an estimated overuse between 20 and 50%, stimulated by suppliers who intend to avoid the high taxes on export which increased by 150% in 2008 and both to profit from exemption and support for import. Since 1980 several sustained government to government efforts have also improved genetic material.

## New patterns

The alignment of China with western patterns occurs first of all in city centers, especially in big cities. Shanghai, for example, attained since the nineties the demographic trend of zero population growth. Shanghai had below replacement fertility rate since 1971, when the total fertility rate (TFR) was 1.84 children/woman. China's age pyramid showed 28% of total population aged under 15 years in 1990 compared to Shanghai's 18%. Shanghai's elderly amounted to 14% of total population compared to 9% of China's population older than 60 years. Shanghai's fertility declines were largely due to 30 years of family planning: the one child rate, the contraceptive usage rate, the one-child certificate, and the sterilization rate. These measures were already diffused in the 1970s, when family planning became widespread in China while Shanghai was ahead of China in socioeconomic growth. (Gu, 1995).

The national urban policy of the early 1980s, which is now the China's Urban Planning Law, was intended to control the size of large cities, to develop medium sized cities, or small cities.

Most cities are beyond their population control limit; the percentage of the nonagricultural population (NAP) living in cities of a million or more inhabitants increased from 37.5% in 1978 to 41.6% in 1990, but the share of NAP living in small cities increased only to 21.5% in 1990. However, large cities had played important roles in development, offering greater efficiency in the industrial labor force and more profits; centers for culture, education, politics, and transportation; and links to foreign countries. (Wei, 1994).

Wu Wenjie utilized in 2009 the city centrality index (CCI) and the spatial data field model to analyze the evolution process and features of sub-region and urban spatial interaction in the Beijing-Shanghai Corridor including 18 cities. Through the analysis, he found that: "with the improvement of the urbanization level and the development of urban economy, the cities' CCI grew, the urban spatial radiative potential enhanced and the radiative range expanded gradually". All this reflects the great increase of urban spatial interaction's intensity; "although the spatial interaction intensity among cities and sub-regions in the Beijing-Shanghai Corridor has been growing constantly. The gap of the spatial interaction strength among different cities and sub-regions was widening, and the spatial division between the developed areas and the less developed areas was obvious. The intensity of the spatial interaction of Beijing, Shanghai and their urban agglomerations was far greater than that in small cities of other parts of the corridor, and it may have a strong drive force on the choice of spatial location of the economic activities" (p.130).

Large numbers of people have migrated to the large cities because there they were assured the life-long security of employment in state-owned industries - the "iron rice bowl." However, China's present policy tries to limit the size of big cities, develop medium-sized cities - between 200,000 and 500,000 people, and encourage the growth of small cities. China's 7th Five-Year Plan (1986-1990) called for a massive movement of the agricultural labor force, not to the cities, but to the towns. To control population movement China instituted the Household Registration System in accordance with which a household must obtain permission to move permanently beyond the local area. Migration from the populous East Coast areas to the underdeveloped Northwest and to the rural impoverished areas of Gansu, Ningxia, and Qinghai is encouraged.

The metro regions have markedly different demographic, employment, migration, and foreign investment patterns from other parts of China. Such patterns stabilized the future form of China's urbanization when the country entered a period of accelerated urbanization (Pannel, 1995).

## Food intake models

Rapid changes in diet or activity which cause obesity and health costs are widespread, now faced by billions of residents of lower- and middle-income countries and are cause for great concern. Linked with these changes will be a rapid increase in chronic diseases.

Tremendous rise in new consumes is originated by rapid income growth, promotion by the government and industry, changes in urban lifestyles, development of new sophisticated marketing channels, increased dairy herd, opportunities for exporting and importing firms. The expansion of television advertisements (Fuller et al, 2006) has changed the traditional consumes based principally on vegetables and corn, now evolved towards more meat, fish, sugar<sup>1</sup>, fruits and dairy products. This repeats the renown alimentary transition, which occurred during centuries in developed countries, but in China is evolving in only few decades.

Several components of urbanization influence health status. Migration to the urban environment imparts the tendency to acquire the health characteristics of the host population (William, 1990). Rapid urbanization causes problems of psychosocial adjustment; urbanization in developing countries compels people to adjust to a global change. Chen, Zhuo and Crawford (2012) suggest to re-examine the role of geographic scale in measuring income inequality and testing the income inequality hypothesis (IIH) as an explanation of health disparities. They sustain that the role of geographic scale should be more rigorously considered in social determinants of health research.

Beijing is experiencing an unprecedented environmental degradation accompanied by complex interactions between urbanization and global environmental change, which places human health at risk on a large spatial and temporal scale. Also politicians do recognize the urgent health risks from environmental changes related to urbanization. A range of urban health hazards and associated health risks in Beijing result from a variety of factors including heat islands, air pollution, water crisis, soil pollution, infectious diseases, and urban consumerism (Qi, Yang, Wang, 2007).

Through China Health and Nutrition Surveys, authors find that physical activity declines were strongly associated with greater availability of higher educational institutions, housing infrastructure, sanitation improvements and the economic wellbeing of the community in which people inhabit. These urbanization factors predict more than four-fifths of the decline in occupational physical activity over the 1991-2006 period for men and nearly two-thirds of the decline for women. They are also associated with 57% decline in total physical activity for men and 40% of the decline for women.

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<sup>1</sup> One of the fastest growing commodities is sugar, mainly for industrial use, rather than for direct human consumption.

New threats are more affecting urban population who has more sedentary habits. Self-reported health status of urban residents is consistently worse than their rural counterparts, based on multivariate logistic regression analysis. Urban residents are significantly more likely to have activity limitations due to illness. Populations experiencing urbanization tend to consume more alcohol and smoke more. The consequences are seen in an increased share of obesity, diabetes, high blood pressure and new emerging diseases, principally related to food intake. One in six Chinese adults is hypertensive, but only one quarter are aware of their condition. Because of the rapid change in lifestyle in China, there is concern that diabetes may become epidemic and because of rapid change in lifestyle risk factors, cardiovascular disease has become the leading cause of death in China.

## Conclusions

The results of the 2012's work of Bai (& al) suggest that under its current economic growth model, it might be difficult for China to control urban expansion without sacrificing economic growth, and China's policy to stop the loss of agricultural land, for food security, might be challenged by its policy to promote economic growth through urbanization. Urbanization itself, connected to higher incomes and higher consumerism is leading to new challenges posed by rich economies especially in the health realm. There is a hope that the rapidity of Chinese lifestyles would overcome the steps of the transition, going directly to the last point of gaining health through functional food. China will certainly be able to do that, helped in this by the restoration of the traditional health habits.

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**A NEW MAP OF RURAL CHINA:  
AN ANALYSIS OF LIVING CONDITIONS AND DYNAMIC CHANGES**

Abstract: In this paper the main emphasis is placed on classifying rural areas in China on the basis of living conditions. The paper describes the transportation facilities, Electric power, culture and education, environmental health and sanitation facilities, medical care, market development, and access to clean drinking water in different areas of rural China. The paper also includes general socioeconomic indicators. The initial objective is to use the characteristics of living conditions in rural China to describe the regional differences, and in this way classify the rural areas. The methodology used to accomplish this objective is principal component analysis and cluster analysis, based on data from the Second Chinese National Agricultural Census (2009) and the China Statistical Yearbook (2007, 2010).

Keywords: Clustering Rural China, Living conditions, Economic Development, China, Rural Economy, PCA

JEL code: O18; Q18; R11

Introduction: The Chinese economy and rural and urban areas<sup>2</sup>

The rapid development of the Chinese economy in recent decades has been due to the combined effects of several reforms. The liberalization of agriculture, beginning with the “open doors” policy and “household responsibility system” and continuing with the latest reforms (such as direct subsidies for grain producers), has changed rural China dramatically. There are, however, many aspects of these changes that are less well known. In our opinion this is not only because of the sheer size of China but also because of the lack of homogeneous information on the enormously large and varied rural areas, where, even now, more than 50% of the Chinese populations still live. Chinese economic

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2 A first version of this paper has been presented at the XVI World Congress of IEA, held in Beijing in July 2011.

development has created great regional differences, as well as enormous demographic changes. There has been, on one hand, an increase in the population, albeit at lower rate than in the past, and, on the other, an increase in urbanization.

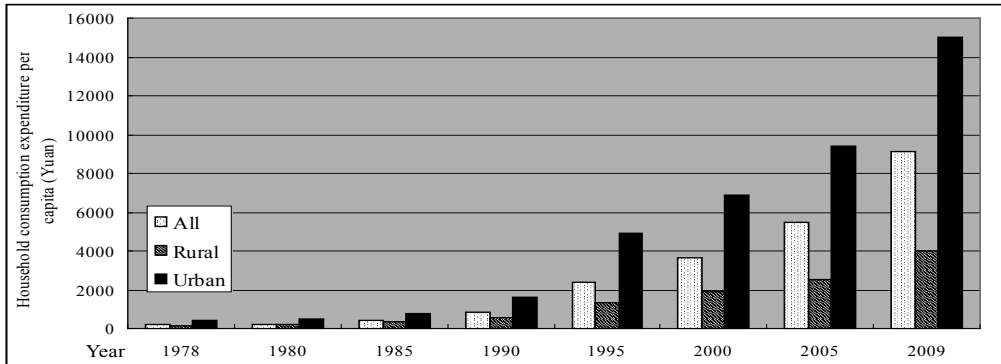
According to the 2010 Population Census, the Chinese population is now about 1.35 billion, compared to just over 962 million in 1978.<sup>3</sup> The urban population has grown from around 172 million to over 621 million during the same period, increasing at an average rate of 4.2% a year. The population increase of 400 million was exclusively concentrated in the urban areas. Today more than 46% of the Chinese population lives in urban areas, compared with just over 18% thirty years ago. Indeed the rural population fell from 790 million (82% of the population in 1978) to less than 710 million, or 53% of the population, in 2009. The population concentrations in urban areas and enormous migrations have an enormous impact on the economic and social structure of both rural and urban area. Urbanization plays an important role not only in increasing the inequalities among provinces and between the rural and urban areas, but also at family level.

This disparity between the provinces and the municipalities has been increasing in favor of Beijing, Shanghai and the East coast provinces during the same period, and particularly in the last twenty years. Only around a third of the Chinese population lives in the East coast, yet they produce more than 55% of the GDP and are responsible for almost 80% of Chinese trade with the rest of the world. Development and per capita income are much lower in the vast central provinces and particularly in the mountainous Western frontier provinces. This disparity is accentuated and more evident when one uses the percentage of the population involved in agriculture as an indicator of the level of economic development, and the per capita GDP as an indicator of wealth. We find that there is a clear negative correlation between these variables. In most Chinese provinces the agricultural workforce makes up between 40% and 60% of the total (with Tibet being the extreme case with 65%), and the per capita income is between 10,000 and 20,000 Yuan. However a growing number of provinces are reducing the agricultural workforce and thus increasing by a still greater amount the per capita income of the population. These are the richer Eastern provinces, with Beijing and Shanghai being the extreme cases. Here the agricultural workforce makes up about 5% of the population and the per capita income is 57,000 and 67,000 Yuan respectively, which is four times higher than that of most of the other Chinese provinces.

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<sup>3</sup> The rate of population increase has been more than 1.1% per year for the last thirty years, although there was a marked reduction due to birth control policies. Thus it fell from 1.5% in the 1980s to just over 0.6% in the new millennium (2000-2007).

Figure 1 Household consumption expenditure per capita in China-(Yuan at current prices)



Source: own processing based on the data from the China Statistical Yearbook, 2010

The aim of this paper is to describe social and living conditions in rural China which are directly influenced by the rapid agricultural and economic development of the last 20 years. Our main focus will be on the territorial disparities among the 31 provinces and municipalities in China. The reason we choose social conditions as our major area of enquiry is as follows: first, the livelihoods of rural residents are one of the most significant and direct indicators for evaluating socioeconomic development in rural areas, especially bearing in mind the new guidelines for “Building the New Socialist Countryside” proposed by the Chinese government; second, we would like to investigate some interesting perspectives obtained by taking the social and living variables into consideration, in order to create a different map of rural China. This can then be compared with the traditional agricultural and socio-economic areas that are used in the official geographical classification of China.

A new map of Chinese rural areas will be created which can be compared with other territorial clusters, even though, unfortunately, there is still no clear identification of rural areas. However clustering Chinese provinces by social parameters and living conditions may be a starting point for improving the quality of integrated and diversified policies and projects for rural areas in China. It will also provide useful information on crucial issues in the future economic and social restructuring of China, and in particular on whether regional differences will persist. (First and Second National Agricultural Census in China 1996-2006).

There have been two national agricultural censuses of rural areas in China in 1996 and 2006. It measured agricultural production and management, the social conditions of townships and village committees and communities, land use, investment in fixed assets, the farm labor force and migration, and farmers’ livelihoods. The aim was to improve our understanding of the real



structure and the developments in agriculture and rural areas, and the different types of households and the role that they played, hence to provide information in developing national strategies and planning.

In this paper we mainly use the data from the second census on the social conditions in the villages of rural areas, with specific focus on the variables which concern infrastructure and resident livelihood. We believe that social conditions directly reflect the overall living standards in rural areas, so we use these to create a new map of rural China. There were more than 637,000 of these and they were the lowest administrative level at which data were collected. The 31 variables selected and used in our analysis relate to four main aspects of rural life: 1) Transportation facilities, 2) Electrical power, 3) Culture, Education, 4) Environment, health, 5) Medical Care, 6) Market development, 7) drinking water, 8) sanitation facilities. Secondary data about public health taken from National Agricultural Census (2006) are used and calculated, as appropriate.

*Principal Component Analysis (PCA): seven components of living conditions*

Principal component analysis (PCA) is a data reduction method, which helps to summarize and order the information in a large data set, hence to avoid double counting. Hotelling (1993) introduced the most famous formulation of PCA, while the methodology itself comes from Pearson (1901). Here we extracted seven components with eigenvalues greater than 1, which were able to explain nearly 89.2% of the initial variances (see table 1).

*Table 1 Total Variance Explained*

Component	Initial Eigenvalues		
	Total	% of Variance	Cumulative %
1	12.264	39.561	39.561
2	6.541	21.101	60.662
3	2.864	9.240	69.903
4	2.174	7.013	76.916
5	1.632	5.264	82.179
6	1.171	3.777	85.957
7	1.004	3.237	89.194
8	.774	2.496	91.690

*Source: own processing on data from the Second National Agricultural Census in China (2009)*

## Clustering rural China: regional differences of social conditions

Cluster analysis is applied in the following section, based on the components extracted by PCA. Here Ward's hierarchical method is used, because the sample size is not large enough<sup>4</sup>. The Euclidean measure of distance is used<sup>5</sup>. For a generic number of co-ordinates<sup>n</sup>, the equation between two observations *i* and *j* is as follows:

$$D_{ij} = \sqrt{\sum_{k=1}^n (x_{ki} - x_{kj})^2} \quad (3)$$

where  $x_{ki}$  is the measurement of the *k*-th variable on the *i*-th observation. All of the data are processed by the statistic software SPSS. What we hope to obtain from our analysis is new clusters and a new map of rural China which can then be compared with the traditional ones, hence to provide useful information for policy makers. The results of final cluster of Chinese provinces are as follows:

**Table 2 Final Clusters of rural China**

Cluster	Provinces and Municipalities
1. Coastal Developed	Beijing, Tianjin, Shanghai, Jiangsu, Zhejiang, Shandong
2. Second Belt	Hebei, Liaoning, Jilin, Heilongjiang, Anhui, Fujian, Jiangxi, Henan, Guangdong, Chongqing
3. Mainly Rural China	Shanxi, Nei Mongol (Inner Mongolia), Hubei, Hunan, Guangxi, Hainan, Sichuan, Guizhou, Yunnan, Shaanxi, Gansu, Qinghai, Ningxia, Xinjiang
4. Tibet	Xizang (Tibet)

*Source: own processing based on the Second National Chinese Agricultural Census, 2009*

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<sup>4</sup> In *Ward's method*, the sum of squared distances is firstly computed within each of the clusters, then the aggregation between two clusters with the smallest increase in the total sum of squared distances is chosen.

<sup>5</sup> *Euclidean distance*, the best-known measure of distance, is the length of a line segment connecting two points.

Figure 2 Map of clusters in rural China



Source: own processing

To better evaluate the conditions in each cluster, we used some basic indicators as follows:

Table 3 General Conditions of the Four Clusters

	Cluster 1	Cluster 2	Cluster 3	Cluster 4
Total Population (000 persons) (2009) *	272,790	540,930	499,980	2900
% of total population	21	41	38	1
N. Agricultural Household (000 Unit) §	39,427	79,481	80,855	396.279
N. Agricultural Non-Household (000 Unit) §	98.841	168.616	127.324	0.399
Agricultural HH/ Agricultural Non-HH #	398	471	635	993
N. Migrants (000 persons) §	22,3109	53,385	55,976	140
% migrants/total population #	8.2	9.9	11.2	4.5
% migrants > 10months/total #	58.0	58.5	67.5	29.1
Rural Population (000 persons) *	112,570	273,550	296,620	2210
% of Migrants on rural population #	19,8	19,5	18,9	6,3
Percentage of Rural Population (%) (2006) *	43.82	53.91	65.90	71.79
Percentage of Rural Population (%) (2009) *	41.27	50.57	62.32	76.2
Percentage of Agriculture in Gross Regional* **Product (%) (2006)*	5.99	11.69	17.54	17.49
Percentage of Agriculture in Gross Regional* Product (%) (2009)*	5.56	10.38	15.53	14.47
Urban/rural Consumption Ratio (rural hhs=1) (2006)*	2.53	3.11	3.78	4.00
Urban/rural Consumption Ratio (rural hhs=1) (2009)*	2.45	3.19	3.66	4.00

Average level of Per Capita Net Income of Rural Households by Region (yuan) (2006)*	6859.74	3756.38	2551.35	2435.02
Average level of Per Capita Net Income of Rural Households by Region (yuan) (2009)*	9494.79	5403.21	3725.68	3531.72
Area of Cultivated land per hhs (hectares/hhs) #	0.33	0.57	0.76	0.88
Area of Cultivated land per person (hectares/person) #	0.14	0.17	0.20	0.18
Percentage of Employed Labour in Primary Sector in Rural area §	48.41	69.84	86.21	92.07

Sources: \* *China Statistical Yearbook, 2006 and 2010*; § *The Second National Chinese Agricultural Census, 2009*; # Our elaboration on the data from the *China Statistical Yearbook, 2006 and 2010* and *The Second National Chinese Agricultural Census, 2009*

The first cluster consists of 6 provinces, but with more the 272 million persons (21% of total China) and the lowest level of rural population (112 million, 41% of total in 2009). All of them are in the eastern coastal area, on the axis Beijing-Shanghai. They share similar characteristics of great social and economic development. This is due to both the policies of the Chinese government and their geographical advantages. In table 4 we can see that the percentage of the rural population fell from 2006 to 2009. However it is worth mentioning that this percentage is still high, and is almost more than 40% of the total population. This explains why it is correct to say that the rural areas are of great importance even in the most urbanized Chinese provinces.

The fall in the percentage of the rural population in these areas also explains why agriculture makes up a continually falling proportion of the Gross Regional Product. Now it is no less than 6% of the total. The consumption ratio is also lower in cluster 1, with less than 2,5 in 2009. This is because of the differences in consumption levels between urban and rural areas are less dramatic as they are in other clusters, and these differences are decreasing in recent years. The average net income of this cluster is much higher than in the other three, which is an indicator of the better economic situation and living conditions. The area of cultivated land and proportion of labor employed in agriculture are the lowest among the four clusters, which is further proof of the explanations above. In general we can say cluster highest urbanization levels in rural areas. The presence of migrant is relevant also in these richest provinces, with more than 22 million (17% of Chinese migrant of rural areas with about 58% who stay more than 10 months out of home).

The second cluster consists of 10 provinces and municipalities, but the their geographical location covers a far wider area from North East (Heilongjiang) to South East (Guangdong), similar to a belt around cluster 1, including also the more developed municipalities of Chongqing. This cluster has

more than 540 million persons (41% of China) with more than 50% of rural population. These areas share a common long agricultural history and favorable natural conditions. From the table 4 we can see that in this cluster the proportion of rural population, agriculture proportion of the Gross Regional Product, consumption ratio, area of cultivated land and proportion of labor employed in agriculture are the second lowest, and also that the first three of these indicators are tending to fall. The net income of rural households is the second highest, and is increasing with time. The provinces in this cluster are not as developed as those in the first cluster, for many reasons. Basically they are in the period of transition to industrialization, which actually makes higher demands on the rural areas.

The third cluster consists of 14 provinces and municipalities, mostly located in the Central areas and Southern and Western peripheral China. They have a little less than 500 million persons (38% of the total) but the rural population increase to more than 65%. Also the relevance of agriculture improved, not only as GDP (17% of China), but especially as the importance of agricultural employment. The overall performance of this cluster is similar to that of cluster 2, which means that here too agriculture plays a more significant role in the economic and social structure, but is at a relatively lower level of development. The indicator of average agricultural land per person is the highest among all the clusters.. One should also note that the per capita net income of rural households in this cluster is similar to that in cluster 4 (Tibet), and dramatically lower than in cluster 1 (more than 2.5 time) and 2 (about 70%), while the rural population makes up a larger percentage of the total population and agriculture plays an important role in the Gross Regional Products. This indicates that this cluster is relatively underdeveloped, that agriculture operates at a low level of efficiency, and that living standards in rural areas need to be improved. The difficulties of this area are also underlined by the large presence of migrants, a little less than 56 million, with more than 67% who stay out of home for more than 10 months, generally out of the provinces of origin.

The fourth cluster consists only of Tibet. Tibet is indeed interesting because here there are special and particular natural and socioeconomic factors in play. In this autonomous region all the indicators are lower, but with a per capita income similar to cluster 3. In Tibet the presence of migrant is much less than the other clusters. The indicators for cultivated land, rural incomes and consumption clearly show its underdeveloped situation of this region compared to other clusters.

Once a general description of the clusters had been obtained, our next task was to analyze living conditions, using the initial variables chosen to classify these. In order to improve the final results of the clusters we report, for each cluster, the average values (arithmetic mean) of the 31 variables used in the Table 4. We now focus on analyzing the most relevant variables, i.e. those that show consistent differences between the clusters of provinces of rural China.

**Table 4 Arithmetic Means of Cluster 1-4**

Component	Variables	Cluster 1	Cluster 2	Cluster 3	Cluster 4 (Tibet)
2	Villages with Highway*	0.983	0.972	0.925	0.645
6	Villages with street lights	0.539	0.194	0.057	0.008
4	Closest Bus Station/Port to Village Community 0km	0.299	0.311	0.208	0.139
6	Closest Bus Station/Port to Village 1-3km	0.579	0.429	0.365	0.083
6	Road Material Cement & Tar (to village) <sup>3</sup>	0.910	0.671	0.379	0.053
6	Road Material Cement & Tar (in village)	0.705	0.388	0.206	0.021
2	Villages with Electricity	0.992	0.997	0.976	0.400
2	Villages with Tel Network	0.991	0.993	0.948	0.498
5	Villages with Kindergarten(s)	0.312	0.377	0.194	0.005
1	Villages with Gym(s)	0.376	0.103	0.066	0.001
7	Villages with Library(ies)	0.302	0.150	0.126	0.099
2	Villages Covered by TV Signal	0.990	0.987	0.957	0.591
5	Villages with Cable TV	0.793	0.645	0.382	0.088
1	Villages with Part-time Performing Teams	0.282	0.158	0.131	0.042
3	Closest Primary School to Village Commune 0km	0.153	0.406	0.367	0.078
6	Closest Primary School to Village Commune 1-3km	0.704	0.490	0.489	0.271
3	Closest Middle School to Village Commune 0km	0.049	0.074	0.058	0.023
6	Closest Middle School to Village Commune 1-3km	0.591	0.429	0.331	0.032
1	Villages with Purified Drinking Water	0.695	0.197	0.150	0.023
1	Villages with Garbage Disposal Sites	0.564	0.148	0.067	0.042
3	Villages with Bio gas Pit	0.082	0.334	0.395	0.013
1	Villages with Improved Toilets	0.535	0.220	0.166	0.058
2	Villages with Clinics	0.729	0.832	0.698	0.111
2	Villages with Qualified Doctors	0.757	0.880	0.693	0.113
3	Villages with Qualified Midwives	0.059	0.206	0.227	0.029
3	Closest Clinic/Hospital to Village Commune 0km	0.067	0.083	0.071	0.063
6	Closest Clinic/Hospital to Village Commune 1-3km	0.594	0.400	0.338	0.174
7	Villages with HHs with License of Tourism	0.038	0.019	0.028	0.013
4	Villages with shops/supermarkets >50m <sup>2</sup>	0.486	0.426	0.238	0.080
6	Villages with motor pump Wells	0.410	0.406	0.238	0.020
5	Villages with water Ponds/Reservoirs	0.252	0.395	0.284	0.193

The word “highway” in the paper refers to well-built public road. This is the definition adopted in the Census book. Source: National Agricultural Census Office of China (2009),.

From table 4 we can also see that the first cluster performed better than the others for most of the variables; the mean values are far higher than for the other clusters. The rural areas in those provinces are, indeed, in general relatively advanced, thanks to the greater financial and technological support that they receive from local government. However, one cannot ignore that agriculture still needs to be repositioned after economic transformation in these rural areas. In the second cluster, we can observe high mean values for the conditions of highway, electricity telephone networks and TV signals; these are almost equal to those of cluster 1. The second cluster also has the highest values for certain variables. It performs best in primary education and medical facilities: the values are highest for kindergartens, primary schools in villages, and clinics and qualified doctors of all the 4 clusters. In the third cluster, we can see that most of its scores are lower than cluster 1 but reasonably similar to those of cluster 2. However there are certain variables that can help to explain the differences between cluster 3 and cluster 2. In particular most of variables related to facilities and infrastructure (street lights; road material; garbage disposal; improved toilets; motor pump wells) are lower in cluster 3 than cluster 2. From Table 4, we can see that this cluster is the closest to a national average. These provinces are basically in a relatively poor and lagging behind stage, especially the rural areas. To some degree there are geographical reasons for this, but political decisions made by the government also play a role in these areas.

The fourth cluster is just Tibet. Its agricultural production and livelihood are different from other regions. From table 4 one can clearly see that Tibet has the lowest scores for most of the indicators. Thus it makes sense to separate out Tibet from other provinces, especially when one considers its history, politics and location.

Some variables are quite similar for the first three clusters, which represent the prevailing conditions in most of rural China (with the exception of Tibet). There are very high values for villages with general services such as electricity, telephone networks and covered by TV signals (more than 95%). Only in Tibet are the values of these fundamental variables for living conditions significantly lower (between 40% and 60%).

The percentage of villages with primary schools inside or close (less than 3 Km.) to them is also high (more than 85%) in the three main clusters. In Tibet, by contrast, the percentage is about 35%.

Kindergartens are much rarer than primary schools in villages, with little more than 31% in cluster 1, more (38%) in cluster 2, and far fewer in cluster 3 (less than 20%) and in Tibet (less than 5%)

There are some significant differences in the transport and communications networks of the villages in the three main clusters, specifically with regard to presence of bus stations inside the

villages or within three kilometers. In the first cluster 90% of villages have these transport facilities, more than 70% in cluster two and a little more than 60% in cluster three. The figure for Tibet is only 20%.

There are other relevant variables where there are significant differences among the first three clusters. These differences are in the very important variables which determine the social and living situations in the villages, such as the presence in the villages of roads with lights, metaled roads with cement or tar, villages with gyms, with cable-TV or with libraries. In general here the values for the first cluster are higher than for the other two.

The value for better village infrastructure, as measured by roads with street lights, is more than 50% in the first cluster and decreases sharply to less than 20% in cluster 2, and is only barely present in villages in cluster 3 (less than 6%), and insignificant in Tibet. There are also great differences in the condition and quality of the roads to or inside the villages. In cluster 1 more than 90% of the villages are connected with metaled or cement roads to the outside world and 70% of the roads inside the villages are also metaled or cement. Cement or metaled road connections the outside world decrease to 76% in cluster 2 (and less than 40% inside the villages) and to less than 40% in cluster 3 (about 20% inside the villages). In Tibet less than 5% of the villages are connected to the outside world by metaled or cement roads.

Access to ICT technologies is high compared to telephone services, but much lower and with greater variations for cable TV (80% in cluster 1, 65% in cluster 2 and less than 40% in cluster 3).

The presence of higher education (middle schools) facilities and education facilities (libraries) varies between the clusters much more greatly than does the presence of primary schools. Middle schools are found in or close to the village in 65% of the villages in cluster 1, in 50% in cluster 2, in around 40% in cluster 3, and in less than 6% in Tibet. There are even greater differences in the presence of libraries in the villages. They are found in only 30% of villages in cluster 1, and in between 15% to 10% of villages in the other three clusters.

Clinics and qualified doctors are common in villages in the first three clusters, with figures of more than 85% in cluster 2 and around 70% in clusters 1 and 3. There is however differences in the proximity of the facilities ranging from 65% in cluster 1 to 40% in cluster 3.

It can also be seen that the percentage of facilities in the village (0 km) of cluster 1 are not as high as the other variables. However the indicators of proximity (near to the village) are still the highest. In our terms this does not mean that the educational and medical facilities are undeveloped in cluster 1. It may be due to the small size of the villages, or that there is better transportation and greater access to urban areas or to the closest towns and townships. By contrast the higher percentage of villages



with schools and hospitals in the villages in cluster 2 and 3 may well be due to the distance of these villages from the nearest towns and townships.

Hygiene levels in villages in rural China are still very low as can be seen from the results for the presence of purified drinking water, garbage disposal, and toilet improvements. The figures are much higher in cluster 1 (70% of villages with drinking water and 56% garbage disposal), whereas in the other clusters the hygiene levels are very low (20% of villages with drinking water in clusters 2 and 3). More than 53% of villages in cluster 1 have improved toilets, but only 22% in cluster 2, 17% in cluster 3 and 6% in Tibet.

The villages have little contact with organized retail outlet systems. Shops larger than 50 square meters are found in only a little more than 45% of villages in clusters 1 and 2, 24% in cluster 3, and are not found in Tibet.

## Conclusions and perspectives

The clustering of the villages of rural China according to their social and living conditions shows there are not only some general and homogenous standards but also very deep differences in many relevant aspects of the quality of life in the villages.

Summing up the first three clusters show decreasing values referred to living condition starting from the most developed one (cluster 1) from Beijing to Shanghai, to the grit belt from North-East to South-East (cluster 2) with lower values for the main variables. The central and western parts (cluster 3) have much lower values of social and living conditions and it represents the largest part of rural China.

We can conclude that the geography of the social and living conditions in China is significantly different from the traditional and official classifications from the Statistical Yearbook and the Agricultural Census. These results will show the need of different policies and actions to avoid the permanence of differences within the rural areas and in particular compared to the fast growing urban areas.

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## **REGIONAL RANKINGS AND DYNAMIC CHANGES IN CHINA: COMPOSITE INDICATOR OF ECONOMIC PERFORMANCES**

**Abstract:** This paper examines the heterogeneous regions in China, with the inequalities not only between coastal area and inner land, urban and rural, but also inside them. Separate indicator index were selected and applied to evaluate and distinguish the economic performances in rural and urban areas. A composite indicator was finally extracted to explicate the regional disparities of China and the long-term projection of convergence or divergence. Principal component analysis, min-max standardization and kernel density were applied.

**Keywords:** Disparity, Regional, Urban, Rural, Mapping, Development

JEL Code: O10, O1

### **Introduction**

Regional inequality in China has been widening up along with its rapid growth since the initiation of economic reforms. There has been, on one hand, a large gap between urban and rural areas, and on the other, uneven development between coastal and inland areas. Commonly the Pareto (80/20) rule is used to describe the disparity in China: a large part of the national wealth has been created and owned by the highly developed regions while their land areas only take a small proportion. Even though the GDP of China is claimed to increase as an average rate of 8% during the last decade, there are still 150 million Chinese living the poverty. Gini coefficient could clearly picture the wide gap in the whole

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nation. It is reported that the Gini coefficient of China has been persistently kept around 0.5 during the recent years<sup>6</sup>, way higher than the official alert line (0.4). Many studies focus on grouping China through the uneven socioeconomic conditions: some were according to the migration and earnings (Y. Zhao, 1999), some based on the correlation of average growth rate and education level (F. Cai, et al., 2002), and some specialized researches focused on the rural classification (R. Fanfani and C. Brasili, 2003). Possible reasons as geographic, historical, and political factors have been analyzed. Even though it is still complicated to totally explain why the deep differences existing and how they changed in the past decades, the economic levels in different regions of China are certainly a significant angle to study.

Our main objective is to group the 31 provinces and municipalities of China by their economic performances in 1996 and 2006 respectively, taking the urban-rural differences into consideration. Firstly the economic performances of urban and rural areas in the two time periods were evaluated separately, on the basis of the selected indicators reflecting the particular conditions of their own. Then the scores of urban and rural areas in every province or municipality calculated from the previous step were combined together to estimate the regional level, and the distributions of urban-rural population were applied as weights. The maps of economic performances on regional dimensions of 1996 and 2006 would be presented, which could also directly show the changes happened in the decade. At last the Kernel density curves were applied to further analyze the developing trends in the two years.

## Data, Methodology And Results

### *Data Collection*

We collected data from the 1996 and 2006 national agricultural census in rural China<sup>7</sup>, China's statistical yearbook, China's city yearbook, all of which are published by China's statistics bureau, so it is reliable and comparable. Here it should be mentioned that Chongqing is designated from Sichuan province as a single municipality in 1997, but some statistical books (e.g. the agricultural census of 1996) has already reported Chongqing separately. As for the statistical data which reported only Sichuan, we estimated the values of Chongqing in 1996 by its ratios of the same indicators in 1997. Also, since most of the data of Tibet in the urban dimension are missing, we finally excluded Tibet as

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6 To calculate the Gini coefficient, there is a common methodology "Income of Five Groups", raised by an economic researcher Z. Hu, in 2004, and widely used and improved by the Chinese researchers, since it is based on the application of the data in China National Yearbook. Based on this method, the Gini coefficient has exceeded 0.5 from 2004, and fell down to 0.47 in 2007, but then bounced back again.

7 The first National census of agriculture and rural areas of 1996 has been the bigger survey never done in the world, with questionnaire for about 200 million rural households and more than 650,000 villages, towns and townships. The Census utilizes more than 7 million enumerators. For more information see Biggeri (2001), Fanfani, Brasili (2001).

an outlier in the urban classification<sup>8</sup>. According to many literatures, Tibet was always removed due to its particular situations and deficiency of data (R. Kanbur and X. Zhang, 2005; F. Cai, et al., 2002). Also, since Tibet is defined as a totally rural region in the OECD rural policy review (2009), we considered the weight of Tibet as 100% rural when we combined its urban and rural scores together.

## Indicator Selection

OECD defines indicators as “... data or combination of data collected and processed for a clearly defined analytical or policy purpose” (Le Gallic, 2002). Since the factors that drive economic growth are different in rural and urban areas, here we selected different indicators to better evaluate their economic conditions and developing levels, respectively. The following is the final list of indicators kept after checking the correlations and significances<sup>9</sup>.

The skewness of the indicators was checked, and Box-Cox transformation<sup>10</sup> was applied to normalize the data.

TABLE 1: Indicators of Economic Performances in Rural and Urban China

Rural Indicators	Urban Indicators
Land productivity	Labor productivity
Investment of fixed assets per capita	Investment of fixed assets per capita
Financial revenue per capita	Retailed sales of consumer goods per capita
Share of non-agricultural employment	Wages per capita of urban inhabitants
Share of rural private employment	Share of urban private employment
Animal husbandry output per capita	Tax of value added in industry per worker
Coverage of towns with special markets	Foreign capital usage per worker
	Unemployment rate

## PCA: Dimensionality

8 Our initial thought was to estimate Tibet by the value of its share in the total GDP (when referring to the indicators measured by currency) and population (when referring to the indicators measured by person) of western area, but the result turned out to be very unreasonable, therefore we finally decided to consider Tibet as a total rural region and remove it in urban dimension.

9 After data collection, we checked the correlation and significance of each indicator with GDP and income in order to delete the non significant and negative related indicators.

10 When it is positively skewed, we normalized the data by the formula:  $x' = \ln(x)$ , when it is negatively skewed, data is normalized by the formula:  $x' = \frac{x^\lambda - 1}{\lambda}$ , ( $\lambda \geq 2$ ).

After the data processing, the samples of 1996 and 2006 were combined together and Principal Component Analysis (PCA) was applied to extract the component scores. PCA is a data reduction method, which aims to summarize and order the information in a large data set, and hence to avoid double counting. Hotelling (1993) introduced the most famous formulation of PCA, while the methodology itself comes from Pearson (1901). Since the objective of PCA is to maximize the variability explained by the components, the total variability of the  $P$  extracted components equals the total variability of the  $P$  original variables. It permits easier selection of a sub-set of components (Mario Mazzocchi, 2008). The equation of PCA can be expressed as follows:

$$(2.3) \quad C = XA' = \begin{cases} c_1 = a_{11}x_1 + a_{12}x_2 + \dots + a_{1p}x_p \\ c_2 = a_{21}x_1 + a_{22}x_2 + \dots + a_{2p}x_p \\ \dots \\ c_p = a_{p1}x_1 + a_{p2}x_2 + \dots + a_{pp}x_p \end{cases}$$

where  $C$  is the  $n \times p$  matrix of principle component scores,  $X$  is the data matrix, and  $A$  is the  $p \times p$  matrix of component loadings. Once the matrix  $A$  has been computed, the component scores can be calculated as follows:

$$(2.4) \quad \hat{a}_{ij} = \frac{a_{ij}}{\sqrt{\lambda_j}}$$

here  $\lambda_j$  is Eigen values. In this paper the components are computed both on covariance and correlation matrices. The initial variables are measured in consistent units (in % terms). In order to run the further step of ranking, the first component was extracted (we considered the first component score should be over 50% when we extracted it).

From the scree plot of PCA (Appendix 1), only the first component extracted in rural dimension is with the Eigen value over than one, contributed nearly 66% of the whole components; whereas two components extracted in urban dimension are with Eigen values over than one, contributed nearly 86% together, while the first component took more than 71% (Appendix 2). Hence, it makes sense to extract the first component as the scales for the further analysis.

### Standardization and Ranking

In this step we applied Min-Max to standardize the component scores and get the rankings. (Appendices 3 and 4)

$$(2.5) \quad x^* = \frac{x - \min}{\max - \min}$$

As for the regional scores, we used the ratios of rural-urban population in every province as the weights to combine their component scores together, and got the final scores at provincial level. Table 2 showed the final ranking at provincial level. Since the min-max sub-scores of 1996 and 2006 were calculated together, it represented not only the economic level of one region compared with others in each year, but also the changes between the two years. From the scores, we could certainly conclude that the whole economic conditions of China improved dramatically, but different regions have been growing in different speeds so the ranking orders have changed also a lot.

When we compared 1996 and 2006, the ranking inside the high developed regions has changed, even though this group still concentrated in the east coast. Beijing, Tianjin and Liaoning upgraded while Fujian degraded, which indicated the economic expansion from the southeast coast to the north coast. However, their ranking scores decreased except Beijing and Tianjin, indicating the enlarge gap inside themselves. The ranking of the middle and undeveloped regions changed dramatically, even though Tibet and Guizhou still remained in the underdeveloped, with the scores less than 50.

TABLE 2: Regional Economic Rankings and Min-max Scores (1996 and 2006)

Regional Rank 1996	Min-max Sub-score	Regional Rank 2006	Min-max Sub-score
Shanghai	73	Shanghai	100
Jiangsu	60	Beijing	90
Guangdong	60	Tianjin	90
Zhejiang	60	Zhejiang	86
Tianjin	57	Jiangsu	85
Fujian	51	Guangdong	84
Beijing	50	Liaoning	78
Shandong	50	Shandong	77
Hebei	49	Fujian	72
Liaoning	49	Hebei	71
Hubei	47	Hainan	68
Hainan	46	Jilin	68
Anhui	44	Anhui	67
Henan	42	Hubei	67
Xinjiang	42	Inner Mongolia	66
Hunan	41	Shanxi	66
Jilin	40	Henan	64
Sichuan	40	Chongqing	64



Guangxi	38	Shaanxi	63
Jiangxi	38	Jiangxi	63
Heilongjiang	37	Hunan	62
Chongqing	37	Ningxia	61
Shaanxi	36	Heilongjiang	60
Shanxi	36	Guangxi	60
Ningxia	34	Xinjiang	59
Inner Mongolia	32	Qinghai	58
Yunnan	31	Sichuan	58
Gansu	30	Gansu	54
Guizhou	30	Yunnan	53
Qinghai	27	Guizhou	47
Tibet	0	Tibet	37

Some central regions started to upgrade, like Inner Mongolia, Chongqing and Shaanxi, while some peripheral regions degraded, like Heilongjiang and Guangxi. The development of the inland, in some degree, could be attributed to the government projects of fostering the central and western regions, such as the main project of China's Western Development Drive, which started from 2000, improving the infrastructure (railroad, electricity and energy), providing investments and tax preferences, supporting local enterprises, and etc. in the central and western regions. Also, a series of the following projects, such as Anti-Poverty, Grain for Green, stimulated the developments in these regions.

#### Mapping China: economic performances and disparities

In order to better describe the ranking results, we divided the 31 provinces and municipalities as five groups by the scale of quintile of the min-max sub-scores in 2006<sup>11</sup>. The first group is defined as with excellent economic performance, ranged from 88 to 100; the second group is defined as with good economic performance, ranged from 75 to 87; the third group is defined as with average economic performance, ranged from 63 to 74; the fourth group is defined as with low economic performance,

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<sup>11</sup> Here we used the scale of quintile of the 2006 scores in both 1996 and 2006, in order to better compare the changes in the two years.

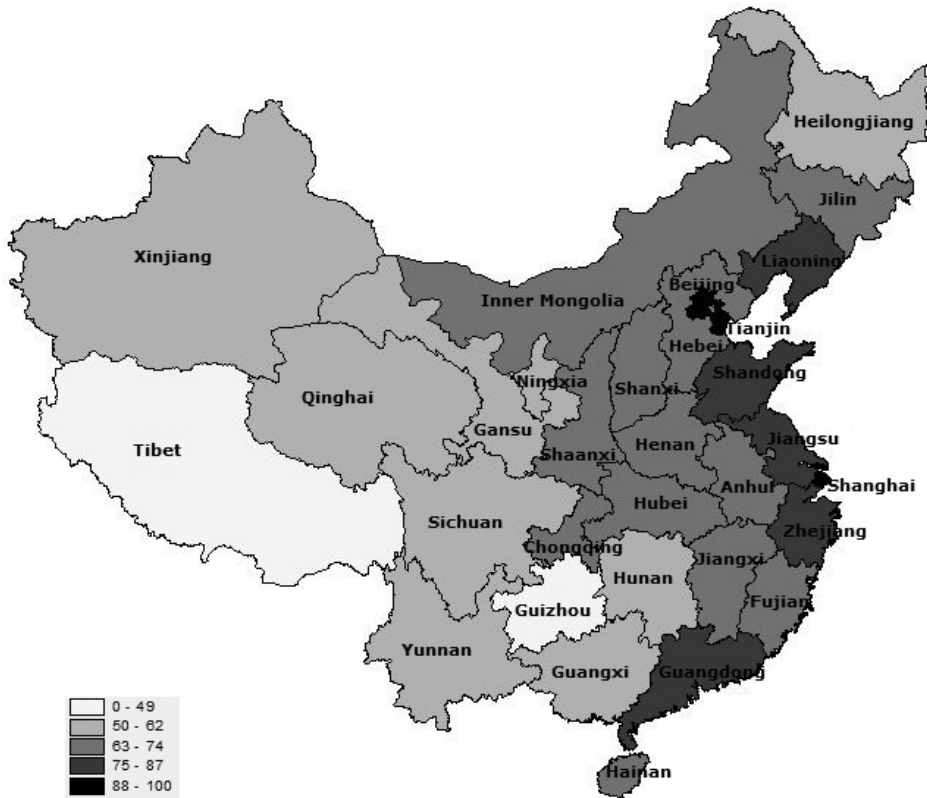
ranged from 50 to 62; the fifth group is defined as with inefficient economics, ranged from 0-49. Same scale was also applied in 1996 to make the two years comparable.

It is obvious that the whole economic situations both in rural and urban China improved. If we compared figure 1 and figure 2, there is a trend of economic expansion from east coast to inland. It indicated the impact of the developed regions started to radiate into central and western China. From figure 1, it is clear that a large part of China were in the light color, representing the underdevelopment of inland regions in 1996. Even though the east coast was in a relatively developed condition compared to inland in this period, most of the regions, if compared with 2006, were just in the level of low economic performances with the min-max sub-scores ranged from 50 to 60, except Shanghai was in the level of average economic performance (with the score 73). The missing parts of good and highest levels in 1996 signified the underdevelopment of the whole country. The fault lines had existed among different regions in 1996's China.

FIGURE 1: Mapping China: Regional Economic Performances in 1996



FIGURE 2: Mapping China: Regional Economic Performances in 2006



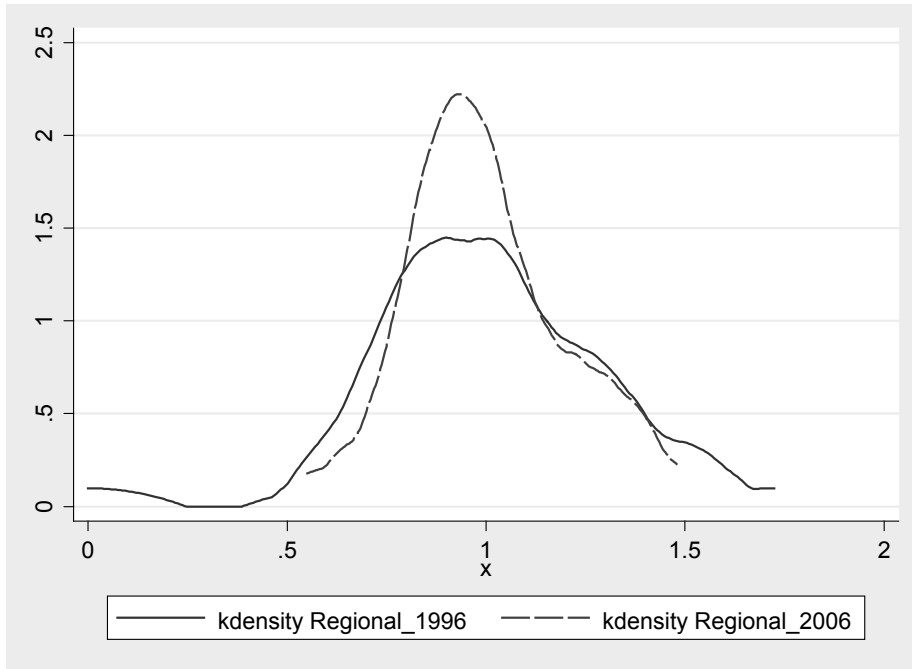
From figure 2, it is obvious that the group of inefficient economics sharply declined to just two provinces, Guizhou and Tibet. Nearly half of inland regions contiguous to the east coast improved to the average level, while the other half locating in the west upgraded to the level of low economic performances. The east coast became more advanced compared with 1996: besides, Shanghai, Beijing and Tianjin ascended to the top group, in the range of 88 to 100; also, the single point (Shanghai) in 1996 was developing to a discontinuous belt in the coastal area. Also, the gap inside the east coast decreased, and the fault lines showed in the whole China in 1996 almost disappeared.

Trend of convergence or divergence: analysis of kernel density

To proceed to the estimation of the Kernel Density function, here we normalized the values of each observation with the correspondent average value for each year. Therefore the outcome has been a distribution centered on an unitary mean value. Owing to the shortage of the data for continuous

time series, this analysis has rather to be seen as an exercise of comparison at two time points in order to understand whether the regions have become closer in terms of economic performances.

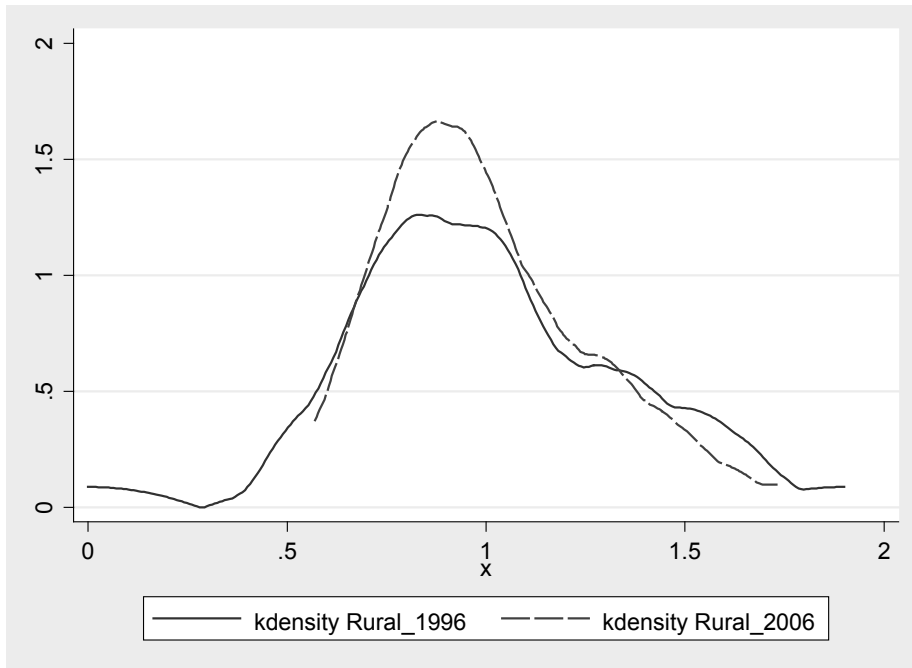
FIGURE 3: Kernel Density of Regional Dimension (1996 and 2006)



From the figure 3, there was a concentration around the mean value in 2006, indicating that the gaps among different regions shrunk down in the time interval. The higher prominence around the mean value in 2006 (nearly 60%) and the shorter tails for both sides showed that more provinces and municipalities were assembling around a greater average level, and the extreme poor and rich group were disappearing.

At the rural level it followed a similar process (figure 4): the distribution in 1996 was more dispersed, or in other words, the distribution was more concentrated around the sample mean in 2006. The left tail of the distribution disappeared, and the density around the unitary mean increased, which indicated the underdeveloped regions started to catch up with the average level, so more regions gathered up around the average level. But the long right-hand tail still remained, demonstrating that the rich regions got richer.

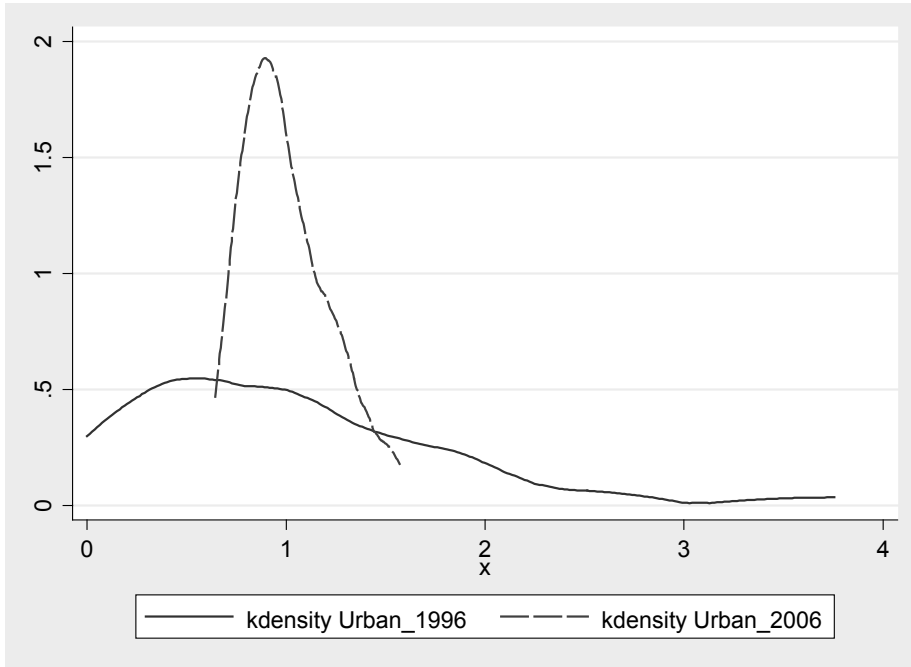
FIGURE 4: Kernel Density of Rural Dimension (1996 and 2006)



In figure 5, the distribution in urban areas was highly dispersed in 1996 (some provinces reached values four times higher than the average), while in 2006 the whole situation improved and the distribution collapsed to a much smaller range of values going from half of the sample mean to one and half times. Therefore, the gaps among different urban areas decreased dramatically from 1996 to 2006. It indeed, in some degree, clarified that the major disparities existed in rural areas of China, while all urban areas developed in a relatively balanced speed.

Even though we cannot declare whether there is a typical convergence or divergence, since the data in the middle of this time interval was missed, it is still safely to say that the levels have become more homogenous in terms of economic performance. All the three figures of kernel density curve showed similar variation tendency in all the dimensions. All of them transformed to unimodal in 2006, and highly concentrated to the average level. Also, the regions under average level in 1996 started to catch up, while the rich regions got richer, and the situation of polarization still remained.

FIGURE 5: Kernel Density of Urban Dimension (1996 and 2006)



## Conclusions

This study addressed one of the major issues in China's economic development: the rural-urban disparities. The indicator index we proposed here, which, however, remained to be perfected with further works, still processed the basic information of the economic conditions in rural and urban areas. In our research, it showed a cascaded distribution according to the geographic locations. From 1996 to 2006, the highly developed economic regions expanded to a non-continuous belt in the east coast, and it started to radiate into the contiguous inland regions; the undeveloped regions shrunk down just to the outlying mountainous areas. Even though the economic performances improved both in rural and urban areas, and the economic level has become more homogeneous: the extremely poor group disappeared and more regions with lower economic performances started to catch up to the average level, however, since the top regions developed faster and got richer, the polarization still remained in the whole country. When it refers to the urban and rural dimensions, the urban economics developed in a more balanced mode, where the polarization abated and a large group gathered around the average level. The rural economics, on the other hand, performed a similar trend of economic

development with the regional dimension, indicating its significant contribution to the national growth. Also, we cannot ignore the disparities existing between rural and urban areas. China has always been a great case that the agricultural reforms could influence the economic development of the whole country, which brought huge productivity by the liberation of surplus agricultural labor shifting to the more productive sectors (industry and service). In order to blunt the polarization coming along with economic growth, more attention should be paid to the rural development, not only to mitigate the disparities existing in itself, but also foster rural areas to catch up with urban economics. In brief, it is significant to make targeted policies for different groups to narrow down the regional inequalities and promote the whole economy. The east coast should be fixed the position of a high-tech belt; in the meantime, it is necessary to transform some of its economic functions into the contiguous inland or even more inland regions, hence to further magnify the positive economic radiation. Special supporting projects should be established for the underdeveloped provinces and municipalities. Also, more efforts should be taken to rural development, following-up works of the tax-free policy and relevant fostering policies should be provided to consolidate the improvements, additionally, particular attentions should be paid to how to properly manage the process of urbanization.

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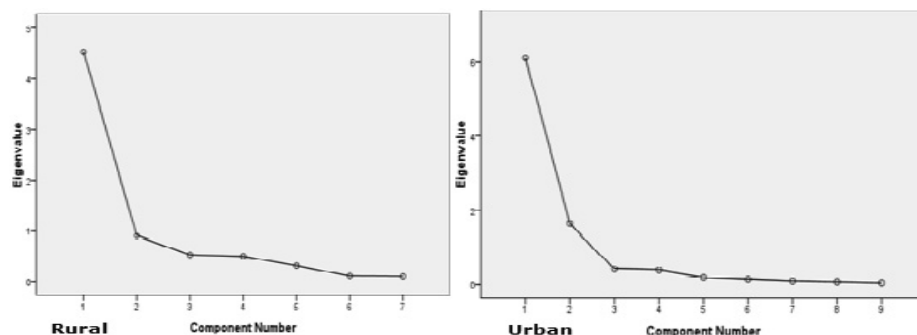
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## Appendices

### Appendix 1. The Scree Plot of PCA of Rural and Urban Components



### Appendix 2. The Component Matrix of PCA

RURAL - Total Variance Explained						
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.54	64.82	64.82	4.54	64.82	64.82
2	0.90	12.90	77.72			
3	0.53	7.57	85.29			
4	0.50	7.17	92.47			
5	0.32	4.54	97.00			
6	0.11	1.56	98.56			
7	0.10	1.44	100			
URBAN - Total Variance Explained						
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.71	71.34	71.34	5.71	71.34	71.34
2	1.17	14.57	85.91	1.17	14.57	85.91
3	0.39	4.81	90.72			
4	0.33	4.13	94.85			
5	0.17	2.17	97.02			
6	0.13	1.59	98.61			
7	0.07	0.89	99.50			
8	0.04	0.50	100			



Appendix 3. Rural Economic Rankings and Min-max Scores (1996 and 2006)

Rural Rank 1996	Min-max Sub-score	Rural Rank 2006	Min-max Sub-score
Shanghai	77	Shanghai	100
Beijing	61	Beijing	84
Zhejiang	61	Zhejiang	83
Tianjin	60	Tianjin	77
Jiangsu	59	Jiangsu	77
Guangdong	58	Guangdong	74
Hebei	49	Shandong	67
Liaoning	48	Hebei	66
Fujian	48	Fujian	66
Shandong	47	Liaoning	63
Hubei	46	Anhui	58
Anhui	42	Hainan	58
Hainan	42	Shanxi	57
Jilin	40	Henan	57
Henan	39	Jiangxi	55
Hunan	37	Hubei	54
Sichuan	37	Hunan	54
Xinjiang	37	Jilin	52
Jiangxi	36	Shaanxi	51
Shanxi	35	Ningxia	51
Guangxi	35	Guangxi	49
Chongqing	34	Sichuan	49
Shaanxi	33	Chongqing	48
Heilongjiang	33	Inner Mongolia	47
Ningxia	29	Qinghai	46
Inner Mongolia	28	Xinjiang	45
Yunnan	27	Heilongjiang	43
Guizhou	27	Gansu	42
Gansu	26	Yunnan	42
Qinghai	23	Guizhou	39
Tibet	0	Tibet	33

*Appendix 4. Urban Economic Rankings and Min-max Scores (1996 and 2006)*

Urban Rank 1996	Min-max Sub-score	Urban Rank 2006	Min-max Sub-score
Shanghai	59	Shanghai	100
Guangdong	37	Tianjin	89
Tianjin	35	Beijing	88
Zhejiang	26	Guangdong	80
Jiangsu	26	Liaoning	78
Beijing	24	Jiangsu	78
Fujian	24	Zhejiang	74
Liaoning	23	Inner Mongolia	74
Hainan	21	Shandong	72
Xinjiang	21	Jilin	69
Shandong	19	Chongqing	66
Ningxia	16	Hubei	64
Hubei	15	Xinjiang	64
Heilongjiang	13	Hainan	61
Hebei	12	Fujian	60
Hunan	11	Shaanxi	59
Sichuan	10	Heilongjiang	58
Guangxi	10	Anhui	58
Yunnan	10	Guangxi	56
Jilin	9	Qinghai	56
Gansu	9	Shanxi	55
Chongqing	8	Gansu	54
Henan	8	Hebei	54
Shaanxi	7	Ningxia	53
Anhui	5	Yunnan	52
Inner Mongolia	5	Hunan	52
Jiangxi	2	Sichuan	51
Shanxi	1	Henan	50
Qinghai	1	Jiangxi	49
Guizhou	0	Guizhou	41

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### **THE CHINA AND ITALY RESEARCH AND LEARNING PROJECT**

Abstract: questo contributo descrive il “China and Italy Research and Learning Project”, progetto lanciato nel 2001 e coordinato dall’Università di Ferrara, incentrato sulle dinamiche di sviluppo industriale di Italia e Cina sullo scenario internazionale, con particolare riferimento alle implicazioni di politica industriale per entrambi i paesi.

The China and Italy Research and Learning Project, launched in 2001, is directed by Prof. Marco R. Di Tommaso, Professor of Applied Economic Studies at the University of Ferrara (Italy) and Honorary Professor at SCUT (South China University of Technology), China.

The project is jointly managed with Prof. Laretta Rubini, Professor of Economics and Firm Organisation at the University of Ferrara (Italy) and researcher at Teknehub – University of Ferrara (Italy) and Prof. Elisa Barbieri, Professor of Economics applied to firm management, organisation and management at the University of Ferrara (Italy) and researcher at the University of Udine (Italy).

During these years of activities the project has benefited from the collaboration of several Italian and Chinese Institutions.

Among them, in alphabetical order: Agenzia per la Cina, c.MET 05 (Inter-university Centre for Applied Economic Studies, University of Firenze, Ferrara and Marche Polytechnics), Emilia Romagna Region Government, General Consulate of Italy in Guangzhou, Government of Guangdong Province, Italian Ministry of Foreign Affairs, Italian Ministry of University and Research, Lombardia Region Government, OECD (Organization for Economic Cooperation and Development), SIPRO Ferrara Province Government, South China University of Technology, Toscana Promozione, Toscana Region Government, University Cattolica di Milano, University of Birmingham, University of Pisa, Zhongshan University.

In synthesis, the project has been focusing on the industrial development dynamics of Italy and China in the international scenario, with particular attention to the industrial policy implications in both countries.

The main activities of the project include: research fieldworks, data collection and analyses, reports and scientific publications, public presentations to conferences, organisation of forums, workshops and seminars, exchange of students and professors, teaching and learning programmes (among which a joint PhD programme between the University of Ferrara and the South China University of Technology).

One of the most prominent activities carried out within the China and Italy Research and Learning Project is “The China and Italy School of Policy” that offers advanced learning programmes on international industry, company strategies and government policies.

The project developed in 2006 at the University of Ferrara (Italy), as a hub of a wider network of universities, research centres and scholars.

Started as a programme for Chinese top officials and policy makers, it now includes a second parallel curriculum addressed to Chinese managers and entrepreneurs.

The School programmes are organized in Italy and they include: academic lectures and seminars with company managers and policy makers; workshops; visits to leading Italian firms; meetings with local, regional and national government institutions. Special case studies based on the Italian experience are also examined and discussed with the participants.

The project is designed in close partnership with Italian and Chinese institutions. It promotes academic training and it favours the elaboration of unique material for joint applied researches and comparative studies. Moreover, by encouraging the dialogue between scholars and policy makers of the two countries, the project is also intended to facilitate the economic and cultural relationships between China and Italy.

Among the main treated topics it is possible to find the following:

- ✓ Local development and international production;
- ✓ Industrial and development policy;
- ✓ Innovation and competitiveness;
- ✓ New strategies for industry and development;
- ✓ Policy evaluation;
- ✓ SMEs, medium-sized enterprises, clusters; Investment attraction policy;
- ✓ “Made in Italy” and “Made in China”;
- ✓ The international crisis;

- ✓ Industrial policy and firm's strategy in the contemporary global market;
- ✓ The “new industries”: health, culture, environment and urban requalification;
- ✓ Innovation in traditional and new industries.

By October 2012, 10 editions of the School took place, targeting managers and policy makers coming from the provinces of Guangdong and Zhejiang.

As regards the other activities carried out within the China and Italy Research and Learning Project, they can be summarised as follows:

(1) Publications (selected):

- Di Tommaso M.R., Rubini L. and Barbieri E. (2012), *Southern China: Industry, Development and Industrial Policy*, Milton Park Abingdon UK, Routledge.
- Barbieri E., Di Tommaso M.R. and Bonnini S. (2012), *Industrial Development Policies and Performances in Southern China: Beyond the Specialised Industrial Cluster Program*, in *China Economic Review* (corrected proofs available online on China Economic Review website).
- Di Tommaso, M.R., Barbieri, E., Huang M., “Industrial Development Policy and Innovation in Southern China: Government targets and firms behaviour”, January 2010, in *European Planning Studies*, Volume 18, n.1, pages 83-105.
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- Bellandi, M., Di Tommaso, M.R., “Guangdong, Cina: un laboratorio per lo studio della nuova industria”, in *Economia e Politica Industriale*, Franco Angeli, n.121-2004.
- Bellandi, M., Di Tommaso, “The case of Specialised Towns in the Guangdong Province, China”, in *European and Planning Studies*, Volume 12, 2004.

(2) Presentations (workshops, conferences, etc.) (selected)

- Rubini L. (with M. Schenkel and Motta L.), *Clusters in Italy: An updated picture of the Italian experience*, presented at the International Forum and Learning Program: Guangdong Specialized Towns. Development Policy and Strategy, Beijiao Town, Shunde District, 6-8<sup>th</sup> April 2011.
- Barbieri E., *Local development policy in Guangdong: policy efficiency and policy effectiveness*, presented at the International Forum and Learning Program: Guangdong Specialized Towns. Development Policy and Strategy, Beijiao Town, Shunde District, 6-8<sup>th</sup> April 2011.
- Di Tommaso M.R., *Local development policy: international literature and practices. Building on the Guangdong specialized towns program*, presented at the International Forum and Learning Program: Guangdong Specialized Towns. Development Policy and Strategy, Beijiao Town, Shunde District, 6-8<sup>th</sup> April 2011.
- Di Tommaso M.R., Economic Development and Industrial Policy in Southern China, presented at the International Workshop “Economic Development and Regional Differentiation in China: Trends and Opportunities”, Florence, 10<sup>th</sup> November 2010.
- Barbieri E. (with Di Tommaso M.R. and Rubini L.), Industrial policy in Southern China: beyond the Specialized Industrial Cluster Program”, presented at the International Conference on Small Business Industrial Clusters in China and Italy, Pescara-Chieti, 28-29 May 2010.
- Di Tommaso, M.R., “Planning and Policies in Guangdong Province. What can we learn”, presented at the OECD Guangdong Territorial Review, OECD-Ministero Sviluppo Economico, Presidenza Consiglio dei Ministri, Roma, 5 May 2010.
- Di Tommaso, M.R., “New opportunities for the development of new economic relations between China and Italy: investing in the Health Industry”, Shanghai Government Health Bureau, Shanghai, China, 15 March 2010.
- Di Tommaso, M.R., “The competition between “Made in Italy” and “Made in China” in international markets: what do we learn?”, Chongqing University, Chongqing, China, 13<sup>th</sup> March 2010.
- Di Tommaso, M.R., “New opportunities for the development of the economic relations between China and Italy”, Consulate General of Italy in Guangzhou, Guangzhou, China, 10<sup>th</sup> March 2010.
- Di Tommaso, M.R., “Politiche per lo sviluppo industriale in Cina. Un percorso interpretativo”, presented at “Industria Asiatica e il “nostro sviluppo locale”, Università L’Orientale, Napoli, 26-27 February 2010.
- Di Tommaso, M.R., “Local Development in Southern China”, presented at “The development of SMEs: policies, actors and problems. A comparison between Japan, China, Argentina and Italy, Istituto Italo-Latino Americano, Rome, 15th January 2010.
- Di Tommaso, M.R., “Le produzioni “Made in Italy” nel contesto internazionale. Novembre 2009: alcune riflessioni per il dibattito di politica industriale”, presented at the workshop: “Misure anticrisi e ristrutturazione industriale”, Facoltà di Economia Università degli Studi di Parma, 5th November 2009.
- Di Tommaso, M.R., “Measuring the intangible contents of goods: the “made in Italy” and “made in China” competition”, EIASM Workshop on “Visualising, Measuring, and Managing Intangibles and Intellectual Capital”, Dresden, Germany, 8th October 2009.
- Rubini L. (with Di Tommaso M.R.), “Made in Italy” e “Made in China” in Europe and in the United

- States: policy implications in crisis times, XXXIII Convegno Nazionale di Economia e Politica Industriale, Ferrara, 25-26 September 2009.
- Di Tommaso, M.R., “China and Italy in the global contemporary markets”, Cervia International Summer School, Istituto per l’Europa Centro-Orientale e Balcanica – University of Bologna, Italy, 11th September 2009.
- Di Tommaso, M.R., Endogenous Institutional Change. Discussing the Case of China, Convegno nazionale AIS-ELO - Associazione Italiana di Sociologia, sezione Economia, Lavoro e Organizzazione Sviluppo, Cagliari, 17-18 September 2009.
- Di Tommaso, M.R., Local Development in the contemporary international scenario: Firms strategies and industrial policies, presented at Seminar on Regional and Urban Development, OECD-National and Development Reform Commission-China Development Research Foundation, Beijing, 26th June 2009.
- Di Tommaso M.R., Made in Italy versus Made in China. Il confronto nei mercati internazionali tra produzioni italiane e cinesi, Scuola Superiore dell’Università degli Studi di Udine, Udine, Italy, 1<sup>st</sup> December 2008.
- Rubini L. (with Baradel, A. and Di Tommaso M.R.), Export overlap between “Made in Italy” and “Made in China”. Data analysis and industrial policy implications, EUNIP 2008, European Network on Industrial Policy, Annual Conference, San Sebastian, Spain, 12/09/2008.
- Barbieri E. (with Di Tommaso M.R. and Huang, M.), Government Policy and Firm Strategy in Southern China: Western Categories and Oriental Practices, EUNIP 2008, European Network on Industrial Policy, Annual Conference, San Sebastian, Spain, 12/09/2008.
- Barbieri E. (with Di Tommaso M.R. and Huang M.), “Government Policy and Firm Strategy in Southern China Specialised Towns: Western Categories and Oriental Practices”, presented at the conference “China’s Three Decades of Economic Reform”, 19th Chinese Economic Association Annual Conference, University of Cambridge, Cambridge, United Kingdom, 1-2 April 2008.
- Di Tommaso M.R., Contemporary International Competition in “Knowledge-intensive Industries”: Firm Strategy and Industrial Policy perspectives. Studying the case of “Made in Italy” and “Made in China”, presented at the South China University of Technology, Guangzhou (China), 28th April 2008.
- Di Tommaso M.R., “Industria Italiana e Domanda Cinese”, presented at the Conference: Gli scenari dell’Asia contemporanea tra locale e globale, Università Orientale di Napoli, Napoli, Italy, 12/3/2008.
- Barbieri E. (with Di Tommaso M.R.), Local Development in Southern China: the Two Hundreds “one-city-one-product” towns, EUNIP 2007, European Network on Industrial Policy, Annual Conference, Prato, Italy, 12-13 September 2007.
- Barbieri E. (with Di Tommaso M.R.), Local Development in Southern China, paper presented at XIV Scientific Conference AISSEC (Associazione Italiana per lo Studio dei Sistemi Economici Comparati), Faculty of Economics, Parma, Italy, 21st June 2007.
- Di Tommaso M.R., Foreign Direct Investment in ASIA. What about Italy and Vietnam?, presented at the Conference “Italy-Vietnam: Production, Markets And Co-Operative Relations”, Hanoi, Vietnam, 25th May 2007.
- Di Tommaso M.R., Studying the Emilia Romagna Region in a perspective of industrial collaboration with China, paper presented at SCUT, Guangzhou (China), 14th September 2006.
- Di Tommaso M.R., Italia-Cina: modelli di sviluppo locale a confronto, paper presented at the Guangdong Government Municipality of Zhouhai, Guangdong (China), 17th September 2006.
- Di Tommaso M.R., Dinamiche di sviluppo locale in Cina e le potenzialità per l’industria italiana, paper presented at the Conference: “Italia-Cina: esperienze, strategie e modelli regionali a confronto”, Bologna, Italy, 14th July 2006.

### 3) Promoted seminars and workshops (selected)

*International Forum and Learning Program: Guangdong Specialized Towns. Development Policy and Strategy.* Speakers: Elisa Barbieri, Marco Di Tommaso, Jingtuo Ye, Paolo Miraglia del Giudice, Ji Ci Wang, Donato Jacobucci, Zheng Ping Fu, Ziran Zhong, Pietro Masina, Hai Feng Sun, Marina Schenkel, Stuart Schweitzer. Beijiao Town, Shunde District, 6-8<sup>th</sup> April 2011.

*Joint Research Colloquia: Company Strategy and Government Industrial Policy – works in progress and proposals for a common research agenda.* Speakers: Elisa Barbieri, Marco Di Tommaso, Zhong Fe, Manli Huang, Donato Iacobucci, Junfeng Liao, Pietro Masina, Zhenquan Sha, Xiaoyu Wang. *South China University of Technology, 12<sup>th</sup> April 2011.*

*Joint Research Laboratory: Firm Strategy and Government Industrial Policy.* Speakers: Marco Di Tommaso, Manli Huang. *South China University of Technology, 29<sup>th</sup> April 2009.*

*International Forum: Emerging Issues in International Contemporary Industry: Firms Strategies and Government Policies in crisis times.* Speakers: Marco Di Tommaso, Elisa Barbieri, Laretta Rubini, Danming Lin, Yan Huang, Zhong Qin, Yinghui Fan, Xu Zhongling, Kong Jing. *Shantou University, 24<sup>th</sup> April 2009.*

*Research Colloquia: informal meeting for the exchange of views.* Speakers: Marco Di Tommaso, Elisa Barbieri, Laretta Rubini, Jiang Wei, Zhou Min-Fei, Yongsheng Xiang, Kong Xiaolei. *Zhejiang University, Hangzhou, 22<sup>nd</sup> April 2009.*

*Seminar: Make it different! Contemporary International Competition in “Knowledge-intensive Industries”: Firm Strategy and Industrial Policy perspectives. Studying the case of “Made in Italy” and “Made in China”,* Speech by Prof. Di Tommaso, Canton (Guangzhou), SCUT – South China University of Technology, April 2008.

*Workshop: Italy and China: Studying the Emilia Romagna Region in a perspective of industrial collaboration with China,* promoted by the University of Ferrara for Italian Government, (Speakers: Mr. Campagnoli, Prof. Di Tommaso, President of the Emilia Romagna Region Errani, Prof. Lan, Prof. Long) Canton (Guangzhou), SCUT – South China University of Technology, September 2006.

*Workshop “Business, Industry and Development in Southern China”,* promoted by the University of Ferrara in the framework of the “China and Italy Research and Learning Project” and in collaboration with SCUT, (Scientific Committee: Prof. Di Tommaso, Prof. Lan; Prof. Long), Canton (Guangzhou), SCUT – South China University of Technology, June 2006.

*Workshop: “Territorial and administrative aspects of Guangdong industrial policy”* promoted by the University of Ferrara in the framework of the “China and Italy Research and Learning Project” and in collaboration with SCUT. Among the participants: Prof. Long, Prof. Lan, Prof. Yang, Prof. Di Tommaso, Dr. Barbieri, Dr. Farini. Canton (Guangzhou), SCUT – South China University of Technology, June, 2006.

*Seminar: “Regional support to the international presence of Italian firms: the case of Emilia Romagna, an alternative approach to districts”,* speech by Dr. Elisa Barbieri, Canton (Guangzhou), SCUT- South China University of Technology, April 2006.

*Workshop: “Perspectives on Industrial Development in Southern China”* promoted by the University of Ferrara in the framework of the “China and Italy Research and Learning Project” and in collaboration with SCUT. Among the participants: Prof. Long, Prof. Lan, Prof. Yang, Prof. Sun, Prof. Di Tommaso, Dr. Elisa Barbieri. Canton (Guangzhou), SCUT – South China University of Technology, April, 2006.

*Workshop: “Italian clusters and Chinese specialised towns: a comparative view”* promoted by the University of Ferrara in the framework of the “China and Italy Research and Learning Project” and in collaboration with SCUT. Among the participants: Prof. Long, Prof. Lan, Prof. Yang, Prof. Sun, Prof. Di Tommaso, Dr. Barbieri. Canton (Guangzhou), SCUT – South China University of Technology, April, 2006.

*Workshop: “Cluster and Specialised Towns in Guangdong Province”* promoted by the University



of Ferrara in the framework of the "China and Italy Research and Learning Project" and in collaboration with SCUT, (Scientific Committee: Prof. Di Tommaso, Prof. Lan, Prof. Long), Canton (*Guangzhou*), *SCUT – South China University of Technology*, November 2005.

*Workshop: "Cluster and Industrial Development"*, promoted by the University of Ferrara in the framework of the "China and Italy Research and Learning Project" and in collaboration with SCUT, (Scientific Committee: Prof. Di Tommaso, Prof. Lan, Prof. Long; among the participants: Prof. Li, Prof. Wang, Prof. Bellandi, Prof. Iacobucci, Dr. Farini, Dr. Gavazzoni, Dr. Baradel, Dr. Caloffi ), Canton (*Guangzhou*), *SCUT – South China University of Technology*, April 2005.

*Round Table: "Italy and Guangdong: Challenges and opportunities for Firms, Territories and Institutions"*, promoted in the framework of the "China and Italy Research and Learning Project" and in collaboration with Italian General Consulate and Lombardia Government Region, Speech by Prof. Di Tommaso, Canton (*Guangzhou*), *SCUT – South China University of Technology*, November 2004

*Workshop: "Local Industrial Development and Firms Strategies"*, promoted by the University of Ferrara in the framework of the "China and Italy Research and Learning Project" and in collaboration with SCUT, (Scientific Committee: Prof. Di Tommaso, Prof. Lan), Canton (*Guangzhou*), *SCUT – South China University of Technology*, June 2003.

*Workshop: "Local Industrial Development and Firm Strategies"*, promoted by the University of Ferrara in the framework of the "China and Italy Research and Learning Project" and in collaboration with SCUT, (Scientific Committee: Prof. Di Tommaso, Prof. Lan), Canton (*Guangzhou*), *SCUT – South China University of Technology*, November 2002.

*The Second China Research and Learning Forum: "The Role of Cooperation among Firms and among Nations"* promoted by the University of Ferrara in collaboration with SCUT, the University of Birmingham (UK), The Institute for Industrial Development Policy, the Guangdong Province Developing Planning Committee, the Italian Consulate in Guangdong (Scientific Committee: Prof. Bianchi, Prof. Di Tommaso, Prof. Lan, Prof. Long, Prof. Sugden, Dr. Rubini), Canton (*Guangzhou*), *SCUT – South China University of Technology*, June 2002.

*Seminar: "The international debate on SMEs: what have we learned?"*, speech by Prof. Di Tommaso, Canton (*Guangzhou*), *SCUT – South China University of Technology*, March 2001.

*The First China Research and Learning Forum: SMEs, Industrial Development and Policy*, promoted by the University of Ferrara in collaboration with SCUT, the University of Birmingham (UK), The Institute for Industrial Development Policy, the Guangdong Province Developing Planning Committee, the Italian Consulate in Guangdong (Scientific Committee: Prof. Bianchi, Prof. Di Tommaso, Prof. Lan, Prof. Long, Prof. Sugden, Dr. Rubini), *Guangzhou*, *SCUT – South China University of Technology*, March 2001.

#### (4) Italian Permanent Desk at the Business School of SCUT (2006-2007)

Directed by Prof. Di Tommaso promoted by the Faculty of Economic Studies of the University of Ferrara in the framework of the "China and Italy Research and Learning Project" and in collaboration with the Business School of SCUT.

#### (5) Exchange of Scholars and Networking

Joint PhD programme between University of Ferrara (Italy) and South China University of Technology, Guangzhou (China).

Missions of Professors of the Business School of SCUT at the Faculty of Economic Studies of the University of Ferrara (2002, 2003, 2005, 2006, 2008): Prof. Lan, Prof. Long, Prof. Li, Prof. Yang.

Missions of Professors of the Faculty of Economic Studies of the University of Ferrara at SCUT

(2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011): Prof. Di Tommaso, Prof. Rubini, Dr. Barbieri.

Prof. Di Tommaso appointed as Honorary Professor at SCUT (South China University of Technology), China, 2008.

Phd of the Business School of SCUT at the Faculty of Economic Studies of the University of Ferrara: the enrolment of PhD students of the SCUT's Business School at the annual Summer School on Industrial Development Policy promoted by the University of Ferrara and the University of Birmingham (2004-2005): Min Wang, Peng Xinyu, Huang Manli, Yan Sun, Hongming Xie.

PhD of the Faculty of Economic Studies of the University of Ferrara for Visiting periods at the Business School of Scut (2004, 2005, 2006, 2007): Dr. Annalisa Baradel, Dr. Enrico Gavazzoni, Dr. Gianluca Farini.

Post-Doc of the Business School of SCUT for research visiting period at the Faculty of Economic Studies of the University of Ferrara (2007-2008): Dr. Manli Huang.

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### **“MADE IN CHINA” VS “MADE IN ITALY”?**

## **UNO STUDIO PRELIMINARE DEI DIFFERENZIALI DI PREZZO NELLE ESPORTAZIONI DI PRODOTTI TRADIZIONALI.**

Abstract: Questo breve contributo si inserisce nel dibattito sulla specializzazione industriale italiana e sulla capacità del nostro sistema produttivo di mantenere la propria capacità competitiva. In particolare, viene proposta una metodologia di confronto fra le esportazioni italiane e cinesi basata sui prezzi unitari volta ad evidenziare la presenza o l'assenza di sovrapposizione tra le esportazioni dei due paesi.

Le particolarità della specializzazione italiana

In letteratura è presente un ampio e vivo dibattito sulle peculiarità della specializzazione industriale italiana, principalmente basata su settori che le classificazioni internazionali (ad esempio OCSE, UNIDO, UNComtrade) definiscono come “tradizionali” o low tech (si vedano, fra gli altri, Quinteri e Lanza 2007; Amighini et al., 2011; De Benedictis et al., 2009; Ferrarini and Scaramazzino, 2011; Prometeia, 2011).

Questa situazione sembra mettere il sistema industriale italiano in una posizione difficile: da una lato una competizione che appare diretta con i paesi cosiddetti emergenti, che mostrano pattern di specializzazione molto simili a quelli nazionali. E dall'altro la difficoltà a convertire le proprie produzioni verso settori a più alto valore aggiunto e a più alto contenuto tecnologico, come mostrano di aver fatto molte delle altre economie avanzate mondiali.

La questione se l'Italia possa, in questo quadro, mantenere una posizione competitiva è controversa. Il fatto che le produzioni Made in Italy siano tuttora concentrate in settori cosiddetti tradizionali è visto da alcuni come segno di un declino dell'industria italiana. Tuttavia, a nostro parere, l'analisi sull'effettiva competitività dell'industria del nostro paese dovrebbe essere effettuata tenendo in considerazione il fatto che anche le industrie “tradizionali” possono differenziarsi per valore aggiunto e contenuto tecnologico, e che non necessariamente essere concentrati nello stesso settore merceologico significa produrre gli stessi beni.

Due beni possono essere considerati simili, e quindi confrontati direttamente, se rispondono allo stesso bisogno. In realtà, questo non succede per tutti i beni che sono inclusi nella stessa categoria merceologica (anche molto specifica, ossia a 5 digit nelle classificazioni internazionali). In sostanza essi possono essere molto diversi tra loro perché soddisfano (o non soddisfano) bisogni diversi. Ad esempio, due borsette da donna soddisfano sicuramente un bisogno comune che è la necessità di avere un contenitore in cui riporre oggetti. Tuttavia ci sono borsette che soddisfano unicamente quel bisogno di base e borsette che invece soddisfano tutta una serie di altri bisogni più complessi (e spesso di carattere intangibile) che vengono espressi dal consumatore moderno, quali il bisogno di segnalare uno status sociale, il bisogno di possedere un oggetto dal design ricercato, ecc. Questo significa che due beni appartenenti alla stessa categoria merceologica possono tuttavia essere fortemente differenziati orizzontalmente, ossia per qualità (Bugamelli, 2007; Lanza and Quintieri, 2007). In alcuni casi tali differenze sono talmente importanti che diventa persino ragionevole affermare che siano differenziati verticalmente. In altre parole, le differenti caratteristiche (tangibili ed intangibili) dei beni, seppur inclusi nella stessa categoria a 5 digit, li rendono in grado di rispondere a diverse domande espresse dai consumatori. Tali caratteristiche possono essere sia specifiche del prodotto ma anche fattori di carattere più generale, come la reputazione e l'immagine del territorio o del paese di origine.

Per approfondire questa tesi, abbiamo scelto di confrontare alcune selezionate produzioni italiane e cinesi, data l'attuale rilevanza politico-strategica di questo confronto. In particolare, abbiamo elaborato un indice che permetta di quantificare quanto "diversi" i consumatori mostrano di considerare beni prodotti dai due paesi e inclusi nella stessa categoria merceologica, e che quindi solo superficialmente potrebbero apparire come "simili" (Di Tommaso and Rubini, 2012; Di Tommaso and Rubini 2009; Di Tommaso and Dragomirescu, 2009; Barbieri et al., 2009).

Tuttavia, si intende sottolineare che si tratta di un caso studio, e che come tale i risultati sono limitati allo stesso. Tuttavia, la metodologia che utilizziamo può facilmente essere estesa ad altri casi ed utilizzata per comparare paesi e mercati differenti.

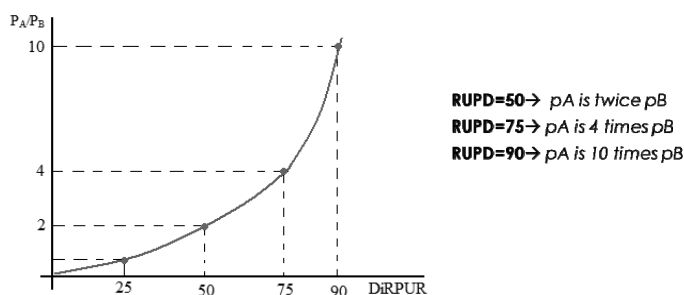
Il differenziale relativo di prezzi unitari rivelati (DiRPUR)

Al fine di cercare di quantificare le differenze qualitative tra due beni appartenenti alla stessa categoria merceologica, abbiamo elaborato un indice, il "differenziale relativo di prezzi unitari rivelati" (DiRPUR), così formulato:

$$\frac{\text{Prezzo unitario ITA} - \text{Prezzo Unitario CHI}}{\text{Max (Prezzo unitario ITA, CHI)}}$$

L'indice assume valori che vanno da 100 a -100. Se ha valore positivo significa che il prezzo italiano è superiore di quello cinese e indica quanto di più il consumatore di uno stesso mercato è disposto a pagare per un prodotto italiano rispetto ad un prodotto cinese (e viceversa se l'indice è negativo). L'ipotesi alla base dell'indice è che se un consumatore percepisce differenze qualitative in due prodotti appartenenti alla stessa categoria merceologica, queste si rifletteranno nel maggiore (o minore) prezzo che è disposto a pagare (Quinteri and Lanza, 2007).

Il DiRPUR assume un andamento esponenziale, come indicato in figura:



Può assumere i seguenti valori:

- [0-25]: DiRPUR basso, indica un potenziale di sovrapposizione alto.
- [25-50]: DiRPUR medio basso, indica una possibilità media di sovrapposizione.
- [50-75]: DiRPUR medio alto, indica una potenziale sovrapposizione piuttosto bassa.
- >75]: DiRPUR molto alto, indica una potenziale sovrapposizione molto bassa.

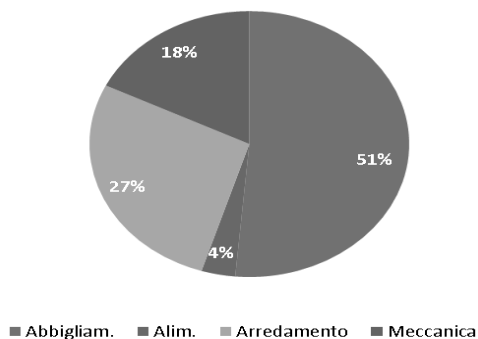
La condizione necessaria perché a nostro avviso si possa escludere la sovrapposizione è che il DiRPUR sia alto e che rimanga alto nel tempo. Questo permette di eliminare i casi in cui il differenziale di prezzo è alto solo perché il consumatore non è pienamente consapevole delle differenze qualitative dei prodotti (ossia perché sono presenti asimmetrie informative).

Il nostro caso studio: un primo confronto Italia-Cina sul mercato Europeo

Nel caso studio qui presentato abbiamo confrontato i prodotti del cosiddetto "Made in Italy" (arredamento, abbigliamento, meccanica e agro-alimentare) a livello di 5-digit (dati UNComtrade, SITC-Rev. 3) per gli anni 2000, 2004, 2008, 2009 e 2010 venduti sul mercato europeo (EU-14). Sono stati considerati solo i settori per i quali erano disponibili dati per tutti gli anni, arrivando ad un database di 496 settori.

Di questi settori, più della metà è data da produzioni legate all'abbigliamento, seguite da arredamento (27%) e meccanica (fig. 1).

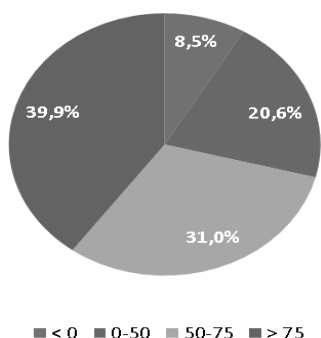
Fig. 1 – I settori analizzati



Fonte: elaborazione degli autori su dati UNComtrade

L'analisi dei DiRPUR evidenzia come il 70% dei settori considerati abbiano un differenziale di prezzo molto positivo, ossia superiore a 50 (fig. 2). Questo è indice del fatto che le produzioni italiane sembrano non sovrapporsi con quelle cinesi in quanto il loro prezzo è nella stragrande maggioranza dei casi molto più alto (il che implica, secondo le nostre ipotesi di partenza, che i prodotti italiani e cinesi hanno caratteristiche diverse in quanto soddisfano bisogni differenti).

Fig. 2 – La distribuzione dei DiRPUR al 2010



Fonte: elaborazione degli autori su dati UNComtrade

Tuttavia, come abbiamo avuto già modo di evidenziare, perché si possa confermare l'ipotesi di non sovrapposizione è necessario che i differenziali si mantengano alti nel tempo. Un'analisi temporale dell'indice rivela che il 53% dei settori mantiene per tutto il periodo considerato un differenziale superiore a 50.

Il nostro caso studio: prospettive future di ricerca

I primi risultati derivati dalla nostra analisi sui differenziali di prezzo indica come l'ipotesi di sovrapposizione tra le produzioni italiane e cinesi sembri essere smentita. Ovviamente si tratta di un primo esercizio che richiede ulteriori approfondimenti prima di portare a suggerimenti specifici e indicazioni di policy.

Innanzitutto è possibile analizzare se siano presenti differenze settoriali nel comportamento dei differenziali, o differenze nelle sotto-tipologie di produzioni (ad es. tra prodotti finiti e componenti).

Inoltre, importanti approfondimenti si possono derivare affiancando lo studio all'analisi dell'andamento delle quote di mercato, al fine di capire se a differenziali di prezzo elevati sono corrisposti aumenti o diminuzioni di quote di mercato. Questo può essere portato avanti tramite un'analisi delle co-varianze, correlazioni statistiche, regressioni o cluster analisi.

Inoltre, l'ipotesi di non-sovrapposizione può essere rafforzata confrontando i risultati ottenuti applicando agli stessi settori gli indici di sovrapposizione più comunemente utilizzati in letteratura (come, ad es., l'indice di Balassa).

Questi approfondimenti suggeriti potranno permettere di uscire ulteriormente dalle semplificazioni (e quindi dai conseguenti suggerimenti di policy) che emergono da classificazioni merceologiche che non tengono conto delle differenze orizzontali tra i prodotti.

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## **THE WTO DISPUTE ON CHINESE EXPORT RESTRICTIONS ON RARE EARTHS: SOME FIRST REMARKS**

Summary: 1. Introduction. 2. Facts of the WTO dispute: the strategic relevance of rare earth elements for the high-tech industry, the global monopoly of China and the supply difficulties for the manufacturing countries. 3. Reactions of the manufacturing countries and industries to Chinese export restrictions. 4. Legal basis of the WTO complaints. 5. Beijing defence. 6. The applicability of GATT Article XX to China's Accession Protocol in the *China – Rare Earths* case: the need to overcome the negative interpretative result of the *China – Raw Materials* case. 7. Conclusive remarks: a *de iure condendo* global solution on exports of natural resources?

### Introduction

On 23 July 2012, the Dispute Settlement Body (DSB) of the World Trade Organization (WTO) established a single panel to examine the complaints brought by the United States, the European Union and Japan against the Chinese export restrictions on rare earth elements (REEs), tungsten and molybdenum.<sup>12</sup> The controversy is very sensitive for at least three series of reasons: a) the economic and strategic relevance of the materials involved in the dispute (rare earths being essential, in particular, for high-tech information, military and green industry); b) the difficult balance to find between mining and trading REEs while protecting the environment and thus respecting the principle of sustainable development enshrined in the Preamble of the Agreement establishing the WTO; c) the challenging

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12 *China - Measures Related to the Exportation of Rare Earths, Tungsten and Molybdenum – Request for the Establishment of a Panel by the United States*, WT/DS431/6, 29 June 2012; *China - Measures Related to the Exportation of Rare Earths, Tungsten and Molybdenum – Request for the Establishment of a Panel by the European Union*, WT/DS432/61, 29 June 2012; *China - Measures Related to the Exportation of Rare Earths, Tungsten and Molybdenum – Request for the Establishment of a Panel by Japan*, WT/DS433/6, 29 June 2012. See ANDORNINO (2012); *Disputes Roundup: Australian Plain Packaging Faces Third Challenge; Rare Earths Panel Established*, in *Bridges Weekly Trade News Digest*, 25 July 2012; also WTO Press Release, *Panel Established on China's Rare Earths Exports*, 23 July 2012.

\*task of defining the relation of the WTO-plus obligation to eliminate export duties, characterizing China's accession to the Marrakech system, with the multilateral public policy exceptions clause enshrined in GATT Article XX.

In this brief essay, we intend to offer a short presentation of the above listed salient aspects of the *China – Rare Earths* controversy also in the light of the recent *China – Raw Materials* case,<sup>13</sup> underlining the fact that the mineral trade dispute may be positively –and durably- settled only if the under regulated area of WTO law on export restrictions is adequately addressed at political level, a target which can be fostered, inspired and supported by a well-balanced interpretative activity of the Geneva jurisdictional pillar.

Facts of the WTO dispute: the strategic relevance of rare earth elements for the high-tech industry, the global monopoly of China and the supply difficulties for the manufacturing countries

Having unique heat resistant, magnetic and phosphorescent properties, rare earths are critical ingredients for many high-tech information, military and green industrial goods -including medical equipment, lasers, laptops, cellular phones, flat screens and displays (LED, LCD, plasma), wind turbines, engines for electric and hybrid vehicles, energy-efficient bulbs, aircraft, satellite, and missile guidance systems.

In spite of their name, REEs are not rare, but widespread in the earth's crust. Their production, however, is almost exclusively concentrated in the People's Republic of China (PRC). In fact, Beijing currently extracts between 95 to 97 percent of REE world's supply,<sup>14</sup> providing also for the successive stages in the mining industry –i.e. smelting, separating and refining. China therefore holds the firm and undisputed global monopoly of rare earths. Such overall supremacy on these strategic supplies has been realized in particular in the last two decades,<sup>15</sup> as in 1990 PRC produced only 27% of REE total world output<sup>16</sup>: China overexploited its natural resources –amounting only at 30 percent of world rare earth

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13 Appellate Body Report, *China – Measures Related to the Exportation of Various Raw Materials (China – Raw Materials)*, WT/DS394/AB/R, WT/DS395/AB/R, WT/DS398/AB/R, adopted 22 February 2012; Panel Report, *China – Measures Related to the Exportation of Various Raw Materials (China – Raw Materials)*, WT/DS394/R and Corr.1, WT/DS395/R and Corr.1, WT/DS398/R and Corr.1, adopted 22 February 2012 as modified by Appellate Body Report (WT/DS394/AB/R, WT/DS395/AB/R, WT/DS398/AB/R). For an analysis of the *China – Raw Materials* dispute see BARONCINI (2011a); BARONCINI (2011b); BOURGEOIS (2011) at pp. 25 ff.; DEMEDEIROS (2011); YA QIN (2012), ROLLAND (2012).

14 *Times Topics – Rare Earths*, *The New York Times*, 13 March 2012.

15 It is very famous the Deng Xiao Ping's 1992 assertion that "the Middle East has oil; China has rare earth" reported *inter alia* by MAY (2010).

16 TSE (2011), at p. 2.

reserves- exporting them also at cut-rate prices, with the consequence of driving out foreign competition, as third countries' mining plants frequently chose to close because of the too high costs brought about by the very demanding environmental and labour legislations imposed by industrialized States.<sup>17</sup>

While high-tech industries based in the US, the EU and Japan became particularly vulnerable to Beijing mineral policy,<sup>18</sup> China started suffering because of the environmental degradation and resource depletion provoked by its REE overexploitation. The Asian Country therefore began, in the second half of the last decade, to limit rare earth exports, with the intention of reducing mining without cutting supplies to its domestic downstream factories –which, on the contrary, Beijing aims at developing and strengthening, incentivizing foreign companies in investing on and transferring know-how to Chinese industries.

The supply difficulties faced by the most technologically advanced non-Chinese companies in obtaining Beijing natural resources significantly worsened in 2010, following the intensification of the diplomatic dispute between Japan and China on the sovereignty over the Diaoyu or Senkaku Islands.<sup>19</sup> Subsequent to the imprisonment by the Japanese authorities of the captain of a Chinese vessel fishing in the waters of the disputed Islands,<sup>20</sup> China decided a marked 40% reduction on exports of rare earths.<sup>21</sup> Such a move once more negatively affected the REE global supply market, with a very sharp increase of the prices of rare earths at international level<sup>22</sup> that, combined with a considerable lowering of REE domestic costs, amounting on average to nearly half of international prices, also created significant competitive advantages for the Chinese manufacturing industry to the detriment of foreign competitors.<sup>23</sup> Many foreign producers, therefore, have been even induced and are still under a considerable pressure to move their operations –together with jobs, investments and technologies- in China, as carrying on manufacturing in the original seats is too expensive and uncertain because of the unreliability of Beijing REEs at reasonable prices.<sup>24</sup>

## Reactions of the manufacturing countries and industries to Chinese export restrictions

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17 On these aspects see BARONCINI (2011a); BARONCINI (2011b).

18 See BRADSHER, CLIFFORD (2012).

19 China calls the Islands Diaoyu, while Japan uses the name Senkaku. On the territorial dispute between the two Asian countries on the Diaoyu/Senkaku Islands see RAMOS-MROSOVSKY (2008).

20 On the diplomatic incident of September 2010 see ZHU (2011), at 434-435; Note, (2011).

21 Japan alone accounts for 50% of China exports of rare earth elements. For a complete overview of the economic, policy and legal aspects of the rare earths issue see GU (2011).

22 For instance, the average export price of rare-earth oxides increased by 537% in 2011 compared to 2010. See FREEDMAN (2012).

23 See MEMO/12/182, *EU Challenges China's Export Restrictions on Rare Earths*, Brussels, 13 March 2012.

24 Cfr. the considerations of the European Union in WTO Press Release, *China Blocks Panel Requests by the US, EU and Japan on "Rare Earths" Dispute*, 10 July 2012.

Manufacturing countries are trying to react to China's export restrictions of rare earths by (re) opening production sites on their territories or promoting the setting up of mines in other States. The site of Mountain Pass (California) -that had to close in 2002, after the leak of radioactive waste leading California to adopt stricter environmental standards, which made production costs too high- is thus active again. Other important factories have been opened on the east coast of Malaysia for treating rare earths imported from Australia, since in the northern State of Pahang legislation is more flexible than in the anglo-saxon country,<sup>25</sup> even if the Australian facilities have had to face opposition from the Malaysian residents on environmental grounds. Further projects of additional sites are being planned in South Africa, Brazil, Canada, Vietnam, Kazakhstan and Greenland, with Japan even considering the idea of offshore exploration for new rare earths' deposits.<sup>26</sup> In addition, high-tech industries are endeavoring to develop new techniques for saving REEs in the manufacturing process, for recycling already used rare earths, and for devising substitutes to such natural elements. However, the new researches are costly and just at their beginning, and remain largely insufficient even if combined with the efforts by the advanced economies to set up new mine plants of rare earths, equally requiring considerable time and funding.<sup>27</sup>

The US, the EU and Japan, in an unprecedented concerted action, also characterized by the fact that Tokyo for the first time is taking Beijing to the Geneva dispute settlement mechanism,<sup>28</sup> have therefore decided to introduce a WTO complaint, holding that Chinese export restrictions are inconsistent with the General Agreement on Tariffs and Trade (GATT) 1994 and China's Accession Protocol to the WTO.<sup>29</sup> They are, in fact, very confident in a positive reaction by the Geneva judiciary,

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25 The [re]opening of mining sites by other WTO countries has already been considered as producing effective competition by the major Chinese rare earth producers. Inner Mongolia Baotou Steel Rare Earth Hi-Tech Co., the largest REE company in China, has declared to expect rivalry in the international market "as resource exploitation picks up in Australia and the United States." Cfr. MOFCOM Press Release, *Baotou Steel Rare-Earth Posts Hefty Profits*, 28 March 2012.

26 Gareth Hatch, analyst at the research firm "Technology Metals Research," has declared that currently there are more than 400 rare-earth projects in 36 countries. See YANG (2012), *Should the World Panic about the China's Control on Rare Earth Export?*, in USC Annenberg, *School for Communication & Journalism*, 3 April 2012, available at <http://ascjweb.org/moneymarketsmedia/?p=566>, accessed in July 2012.

27 BONTRON (2012).

28 Such a choice demonstrates how essential are REEs for the Japanese economy. More generally, commentators observed that the Tokyo attitude to avoid initiating disputes against China in the WTO may be due to a) the fact that many Beijing exports are currently produced by foreign-invested enterprises, with a strong presence of Japanese financing, b) the persistent bilateral trade surplus of Japan with China, and c) the deep influence of Confucianism, the doctrine considering litigation as a means of last resort. On these aspects see ZHUANG (2011) at p. 223. See also GILLISPIE, PFEIFFER (2012).

29 *China - Measures Related to the Exportation of Rare Earths, Tungsten and Molybdenum - Request for consultations by the United States*, WT/DS431/1, 15 March 2012; *China - Measures Related to the Exportation of Rare Earths, Tungsten and Molybdenum - Request for consultations by the European Union*, 15 March 2012, WT/DS432/1; *China - Measures Related to the Exportation of Rare Earths, Tungsten and Molybdenum - Request for consultations by Japan*, WT/DS433/1, 15 March 2012. See EU Press Release, *EU Challenges China's Rare Earth Export Restrictions*, 13 March 2012; US, EU, *Japan Challenge China on Rare Earths*, in *Bridges*, 15 March 2012.

as the legal structure of the *China – Rare Earth* case is extremely similar to that of the *China – Raw Materials* case, where the WTO Appellate Body concluded that Chinese export restrictions on the 9 minerals and metals addressed in that controversy infringed the multilateral trade rules and could not be justified by any WTO public policy exceptions' clause.

#### Legal basis of the WTO complaints

The three complainants claim, *inter alia*, that the Chinese REE export regime involve many quantitative restrictions not respecting the duty to eliminate export quotas, enshrined in GATT Article XI:1, and that the administration of the export measures contravenes GATT Article X:3, as the PRC authorities would not apply the challenged disciplines in “a uniform, impartial and reasonable manner.”

In particular, the US, the EU and Japan argue that the Chinese export restrictions on rare earths infringe also a WTO-plus obligation -i.e. one of the stringent requirements significantly exceeding those accepted by the WTO original membership, undertaken by China, like all the new WTO Members, to gain access to the multilateral trade system. In fact, the export duties on rare earths, tungsten and molybdenum violate China's specific accession commitment to eliminate export tariffs codified at Paragraph 11.3 of the Accession Protocol,<sup>30</sup> as none of the elements considered in the WTO complaints is listed in Annex 6 of such Protocol, contemplating the ad hoc exceptions to the China's WTO-plus obligation.

#### Beijing defence

China claims that its export restrictions are perfectly “in line” with WTO rules,<sup>31</sup> in particular with the general exceptions clause of the GATT, i.e. Article XX. According to the official statements of the Ministry of Commerce (MOFCOM), Beijing rare earth policy “aims to protect resources and environment, and realize sustainable development,” therefore excluding

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30 Pursuant to which “China shall eliminate all taxes and charges applied to exports unless specifically provided for in Annex 6 of this Protocol or applied in conformity with the provisions of Article VIII of the GATT 1994.” It is here to be remarked that within the general WTO system export tariffs are not bound, given that, on the basis of GATT Article II, the binding of tariffs applies only to tariffs on imports.

31 See *Rare Earths Policy “in Line with WTO”*, in *China Daily*, 15 March 2012. See also *No Discrimination in Rare Earth Supply*, in *Xinhuanet.com*, 5 February 2012; *West's Rare Earth Accusation against China Unfair*, in *Xinhua*, 14 March 2012; MOFCOM Press Release, *Spokesman Comments on US, EU and Japan Requests to WTO About Setting Up A Panel on China's Export Measures*, 3 July 2012.

any Chinese “intention of restricting free trade or protecting domestic industries through trade-distorting measures.”<sup>32</sup>

It must be underlined that, subsequent to the dispute in the *China – Raw Materials* case, where the Appellate Body concluded that GATT Article XX cannot be applied to justify violations of the WTO-plus obligation concerning the requirement to eliminate export *duties*, the Asian Country started to reframe and reformulate its rare earth mining policy constantly highlighting that the legal framework of the Chinese REE export regime is based on *quotas* –thus on measures which, if considered to violate GATT Article XI, may also be assessed to ascertain whether they are justifiable under GATT Article XX. Such export quotas are now conferred by the PRC authorities to the local companies mining, processing and distributing rare earths on the basis of their fulfillment of the severe standards fixed by the Chinese discipline. The Ministry of Commerce (MOFCOM) decides the amount and allocates the export quotas in batches, and twice per year.<sup>33</sup> On 11 November 2011, MOFCOM has also established the specific qualifications necessary to Chinese “producers” and “distributors” to be entitled to export quotas, qualifications that comprise the respect of environmental requirements for the mining and processing plants and the activities conducted therein, together with the compliance with social security requirements, and the absence of infringements of a consistent series of Chinese regulations.<sup>34</sup>

Besides many new and articulated legislative measures, China has adopted two very significant policy documents, where it constantly stresses that the purpose of its rare earth legislation is implementing and complying with the principle of sustainable development, i.e. with the research of a proper equilibrium between economic activities and adequate environmental, conservation and health disciplines. In 2011 the State Council issued the “Guidelines on Promoting the Sustainable and Health Development of the Rare Earth Industry”<sup>35</sup>; and, in June 2012, the Information Office of the State

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32 See MOFCOM Press Releases, *China’s Rare Earth Policy Justified*, 15 March 2012; *Earth Export Control at WTO*, 15 March 2012; *Comments by Head of MOFCOM Department Treaty and Law on Us, EU and Japan Requests of Consultations on China Rare Earth Export Control at WTO*, 15 March 2012; *China to Properly Deal with Request for WTO Panel on Rare Earth: Spokesman*, 29 June 2012.

33 The strategic nature of rare earths involve of course the competences of many other PRC authorities. *Inter alia*, at central level, they are the Ministry of Land and Resources, the Ministry of Industry and Information, the State Development Reform Commission, and the Ministry of Environmental Protection and the Ministry of Health. For the best presentation of the Chinese discipline on REE export regime see LIU, LYFOUNG, MAUGHAN (2012).

34 See the *2012 Rare Earth Export Quota Application Qualifications and Procedures*, issued on 11 November 2011 by MOFCOM.

35 Cfr. *Some Suggestions of the State Council on Promoting the Sustainable and Healthy Development of Rare Earth Industry*, issued by the State Council, No. 12(2011), available in the website of the Baotou China Rare Earth Industry Forum, <http://www.creidf.com>. See also *China Issues Guidelines for Rare Earth Industry*, in *China Daily*, 20 May 2011

Council published the White Paper “Situation and Policies of China’s Rare Earth Industry.”<sup>36</sup> Both in the Guidelines and in the White Paper, China tightened and announced the further strengthening of its discipline on rare earth mining, dressing, smelting and separating technologies, asserting that the reinforcement of the national legal framework is absolutely necessary to appropriately deal with a) the conservation problems of the natural resources –if not controlled, it has been predicted that Chinese rare earth reserves could be exhausted in 15–20 years; and b) the enormous environmental damages in the Provinces where REE activities are concentrated –Baotou of Inner Mongolia and Liangshan of Sichuan, together with Ganzhou of Jiangxi Province.<sup>37</sup> In fact, rare earth minerals are naturally associated with many dangerous elements, like radioactive residues, large quantities of toxic and hazardous gases, making their mining and processing destructive for the soil and farmland –with landslides, clogged rivers and polluted aquifers.

Another relevant aspect of the new Beijing rare earth policy is the implementation of the strategy “large enterprises and large groups.” Indeed, as minerals can be mined in small quantities, there has been widespread private, illegal mining in China; and since such activities and private sales have always been difficult for PRC authorities to keep track of, smuggling mining and processing, performed out of any public control, have been a leading cause of environmental pollution and resource depletion. Consequently, by imposing an entrepreneurial structure based on large groups, the PRC aims at having a better control on the observance of the new strict domestic rare earth legislation.

In spite of the remarkable efforts undertaken by China to review and to present its export quantitative restrictions on REEs as an absolutely necessary feature of its rare earth policy -wholly focused on the principle of sustainable development- it is by no means sure that the current Beijing REE export quotas regime can be justified under GATT Article XX. Lit. b) and lit. g) of the GATT general exceptions clause require that the measures to be justified are proven to be “necessary to protect human, animal or plant life or health,” or “relating to the conservation of exhaustible natural resources if such measures are made effective in conjunction with restrictions on domestic production or consumption.” On the basis of the WTO case-law developed until now, it could be difficult to demonstrate that Chinese export quotas are “necessary,” as many specialists claim that less trade-restrictive, reasonably feasible alternatives are available.<sup>38</sup> Furthermore, there is a problem of evidence: since export quotas are defended as measures “necessary” or “relating to” the conservation of natural resources,” objective data have to show that such quantitative restrictions lower domestic production

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36 *Situation and Policies of China’s Rare Earth Industry*, June 2012, available at the website of Xinhuanet.com [http://news.xinhuanet.com/english/business/2012-06/20/c\\_131665123.htm](http://news.xinhuanet.com/english/business/2012-06/20/c_131665123.htm).

37 Cfr. *China “Building Up Rare Earth Reserves,”* in *Xinhuanet.com*, 16 July 2012.

38 See LIU, LYFOUNG, MAUGHAN (2012).

or consumption of rare earths. Available data, however, suggest that both Chinese production and consumption of rare earths have risen.<sup>39</sup>

The applicability of GATT Article XX to China's Accession Protocol in the China – Rare Earths case: the need to overcome the negative interpretative result of the China – Raw Materials case

As we have seen, the US, the EU and Japan also attacked the Chinese export duties imposed on various forms of rare earths, tungsten and molybdenum as they violate the obligation contemplated in Paragraph 11.3 of the Accession Protocol. The infringement of the WTO-plus obligation is very clear; and since none of the recalled materials is contemplated in the closed list of Annex 6 to the AP, concerning the ad hoc exceptions to Paragraph 11.3, the only way China has to avoid being condemned with reference to export duties on rare earths is to try to justify the violation of the WTO-plus obligation relying on GATT Article XX.

Beijing will thus have to argue, for a second time and at a very short temporal distance, the applicability of the GATT general exceptions' clause to Paragraph 11.3 of the Accession Protocol -a claim that, as already mentioned, was poorly rejected by the Appellate Body in the *China – Raw Materials* case.<sup>40</sup> The Asian Country will have to illustrate all the elements and the negative consequences not taken into consideration by the WTO judiciary in the *China – Raw Materials* case, duly stressing the notable weaknesses characterizing the legal reasoning of the Appellate Body, so as to persuade the panel established for assessing the Chinese export restrictions on REEs to revisit the unfortunate AB conclusions on the legal issue here considered. It is, in fact, to be underlined that, as very recently reaffirmed in the *US-Clove Cigarettes* Report, “[i]nterpretations developed by panels and the Appellate Body in the course of dispute settlement proceedings are binding only on the parties to a particular dispute,”<sup>41</sup> for the WTO system does not contemplate the principle of *stare decisis*.<sup>42</sup> This does not mean that WTO precedents can be freely disregarded by a WTO judging body: the Geneva case-law has to be expression of the obligation to provide “security and predictability to the multilateral trading system” established by Article 3.2 of the

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39 Pui-Kwan Tse (2011).

40 For an analysis of the inadequacy of the AB decision on the relation between GATT Article XX and Paragraph 11.3 of China's Accession Protocol see BARONCINI (2012a) and BARONCINI (2012b).

41 Appellate Body Report, *United States - Measures Affecting the Production and Sale of Clove Cigarettes (US – Clove Cigarettes)*, WT/DS406/AB/R, adopted 24 April 2012, para. 258. For a comment see VOON (2012).

42 On the role of precedent before international tribunals cfr. GUILLAUME (2010).



DSU.<sup>43</sup> Such a need for consistency and certainty in the WTO dispute mechanism through the development of a settled jurisprudence (*jurisprudence constante*, or *ständige Rechtsprechung*)<sup>44</sup> on similar legal issues has been interpreted as requiring to be in presence of “cogent reasons”<sup>45</sup> in order to depart from previous, adopted, AB reports. This is the point of equilibrium identified by the WTO judiciary between the duty to ensure, through the dispute settlement mechanism, “security and predictability to the multilateral trading system” under Article 3.2 of the DSU and the obligation on panels of conducting an “objective assessment” of the matter before them pursuant to Article 11 of the DSU.

Therefore, while WTO panels cannot disregard AB findings carelessly, they have, at the same time, to discontinue and diverge from previous, not persuasive conclusions of the Appellate Body when they reach the conviction -assessing the matter brought before them in good faith, as required by Article 31 of the Vienna Convention on the Law of Treaties- that there are new arguments and additional elements in the light of which a particular interpretative approach operated by the Appellate Body needs to be refined and /or revised. In the presence of “flaws” and “systemic difficulties with previous jurisprudence,”<sup>46</sup> we deem that there are “cogent reasons” imposing, on a general basis, to depart from adopted WTO precedents. With specific reference to the applicability of GATT Article XX to Paragraph 11.3 of the Accession Protocol, we are persuaded that revising the negative interpretation of the Appellate Body in the *China - Raw Materials* case so as to reach an hermeneutic result fully respectful of the object and purpose of the WTO –i.e. the possibility to justify the violation of the

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43 “The dispute settlement system of the WTO is a central element in providing *security and predictability to the multilateral trading system*. The Members recognize that it serves to preserve the rights and obligations of Members under the covered agreements, and to clarify the existing provisions of those agreements in accordance with customary rules of interpretation of public international law. Recommendations and rulings of the DSB cannot add to or diminish the rights and obligations provided in the covered agreements.” Article 3.2 of the DSU, emphasis added.

44 See GUILLAUME (2011) at p. 6.

45 “It is well settled that Appellate Body reports are not binding, except with respect to resolving the particular dispute between the parties. [...] This, however, does not mean that subsequent panels are free to disregard the legal interpretations and the *ratio decidendi* contained in previous Appellate Body reports that have been adopted by the DSB. [...] Dispute settlement practice demonstrates that WTO Members attach significance to reasoning provided in support of panel and Appellate Body reports. Adopted panel and Appellate Body reports are often cited by parties in support of legal arguments in dispute settlement proceedings, and are relied upon by panels and the Appellate Body in subsequent disputes. In addition, when enacting or modifying laws and national regulations pertaining to international trade matters, WTO Members take into account the legal interpretation of the covered agreements developed in adopted panel and Appellate Body reports. Thus, the legal interpretation embodied in adopted panel and Appellate Body reports becomes part and parcel of the *acquis* of the WTO dispute settlement system. Ensuring ‘security and predictability’ in the dispute settlement system, as contemplated in Article 3.2 of the DSU, implies that, absent *cogent reasons* [emphasis added], an adjudicatory body will resolve the same legal question in the same way in a subsequent case.” Appellate Body Report, *United States – Final Anti-Dumping Measures on Stainless Steel from Mexico (US – Stainless Steel (Mexico))*, WT/DS344/AB/R, adopted 20 May 2008, paras. 158 and 160.

46 KOLSKY LEWIS (2012) at p. 34. On the role of precedent in the WTO dispute settlement system see also SACERDOTI (2011).

WTO-plus obligation to eliminate export duties on the basis of the GATT general exceptions clause-integrates a “coherent reason” to diverge from the recent unconvincing findings of the Appellate Body.

Conclusive remarks: a *de iure condendo* global solution on exports of natural resources?

In the most optimistic provisions, the panel report on this high-profile ruling is expected by late summer 2013,<sup>47</sup> a time-space likely to be extended in case of appellate proceedings, and to which the WTO granted period for implementation should be added.

Of course, the preferred DSU option of reaching an amicable settlement of the controversy has always to be kept in mind and looked for by the disputants;<sup>48</sup> in this respect, some US politicians have already suggested that Chinese authorities could be particularly sensitive to the claimants’ requests and willing to a prompt settlement of the case under the threat of “US efforts to block Chinese-funded mining projects in the United States as well as World Bank financing for Chinese mining projects.”<sup>49</sup>

In case WTO proceedings go on, because a diplomatic solution cannot be arrived at, in our view China should concentrate on three fronts. At judicial level, Beijing should do its best to overturn the very unfortunate findings of the Appellate Body in the *China – Raw Materials* case on the non-applicability of GATT Article XX to Paragraph 11.3 of the Accession Protocol, showing that such an interpretative result is incompatible with the very object and purpose of the WTO system, i.e. that of promoting a model of economic development which is sustainable, and thus also respectful of the “optimal use of the world’s resources,” as clarified by the Preamble of the WTO Agreement.<sup>50</sup> On the internal side, China should go on -even with greater determination- to reform its rare earth industrial policy in order to upgrade technology and the environmentally friendly management of the economic sector, investing also to remedy the environmental degradation inflicted to some parts of the PRC territories in the last decades of overexploitation. Finally, at international political level,

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47 See *Disputes Roundup: Australian Plain Packaging Faces Third Challenge; Rare Earths Panel Established*, in *Bridges Weekly Trade News Digest*, 25 July 2012.

48 As provided for by Article 3.7 of the DSU, pursuant to which “[t]he aim of the dispute settlement mechanism is to secure a positive solution to a dispute. A solution mutually acceptable to the parties to a dispute and consistent with the covered agreements is clearly to be preferred.” On the importance of diplomatic settlements of WTO controversies see BARONCINI (1999).

49 “These two steps would get China’s attention right away and force them [sic] to reconsider their [sic] unfair practices.” Statements of the US Senator Charles Schumer, reported in AREDDY, REDDY (2012)

50 On the environmental friendly approach now characterizing the Marrakech system, as represented by the new explicit WTO objective of sustainable development, codified in the Preamble of the WTO Agreement, see MARCEAU, WYATT (2009).

Beijing should show leadership, and take the lead for devising an ad hoc legal solution at WTO level, multilaterally regulating exports for the entire WTO membership.

Such new set of international rules defining a common WTO export regime should, at the same time, a) re-establish an equilibrium between original WTO Members and new acceding Members -the former having no duty to eliminate export duties, the latter under the obligation to eliminate or significantly reduce them- and b) strike a balance between the interests of importing countries – essentially, to avoid shortage and price fluctuations in the supply of raw materials- and those of the exporting countries –to maintain sovereignty on, and thus control and preserve, their natural resources, also guaranteeing low prices for domestic needs with the purpose of advancing their industrialization process.

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## **SVILUPPO ECONOMICO E SQUILIBRI TERRITORIALI**

### **I casi dell'Italia e della Cina a confronto**

#### Introduzione

La Cina a partire dal 1980 ha iniziato un intenso processo di sviluppo economico con forti ricadute sociali che ne fa un attore globale in grado di condizionare le dinamiche sia economiche che geopolitiche. Come l'Italia anche la Cina deve confrontarsi con quella che è stata definita la “fatalità geografica” che condiziona non poco le modalità del suo sviluppo. Il parallelo tra le due situazioni va comunque eseguito con cautela dato che, come è stato notato, lo sviluppo cinese ha modi e tempi di azione suoi propri e diversi dalle modalità occidentali, quindi per noi difficilmente comprensibili nella loro interezza quindi rischiano di venire analizzate con criteri inadeguati (Eva 2000, p. 8).

#### Somiglianze e differenze tra Italia e Cina

##### Differenze geografiche

Italia e Cina differiscono per dimensioni del territorio (rispettivamente 301 km<sup>2</sup> e 9.573 mila km<sup>2</sup>) e per popolazione (60 milioni di abitanti e 1.346 milioni); sono accomunate dalla difficoltà delle comunicazioni, dovute in Cina prevalentemente alla vastità del territorio, in Italia dalla forma lunga e stretta e dalla dorsale appenninica. In entrambi i Paesi lo sviluppo è avvenuto nelle regioni geograficamente meglio orientate: in Italia il Nord-Ovest prima seguito poi dal Nord Est e dal Centro, in Cina le regioni costiere.

In entrambi i casi la trasformazione da economia prevalentemente agricola in sistema industriale e terziario si è manifestata con una forte polarizzazione che ha accentuato le differenze fra le aree in sviluppo e quelle meno favorite. In Italia gli effetti della polarizzazione sono stati fortemente attenuati dalle politiche governative a favore del Mezzogiorno.

## Differenze culturali

Alle differenze geografiche tra i due Paesi vanno aggiunte quelle culturali. Nelle diverse regioni del globo la possibilità di entrare in una fase di sviluppo dipende dalle tradizioni, dalla cultura, dalle condizioni sociali dei paesi interessati. La struttura sociale condiziona in modo particolare il passaggio da una società tradizionale alla fase del decollo, cioè il momento fondamentale dello sviluppo.

### L'influenza della religione

I primi a collegare lo sviluppo economico al clima culturale e, in particolare, a quello religioso, furono, come noto, Werner Sombart (*Der moderne Kapitalismus* e *Die Deutsche Volkswirtschaft im neunzehnten Jahrhundert*) e Max Weber. Quest'ultimo, oltre ad esporre le sue tesi più conosciute che prendevano lo spunto dal fatto che ai suoi tempi veniva rilevato in Germania il carattere prevalentemente protestante della proprietà, dell'impresa capitalistica e delle élite operaie più colte (Weber, 1965)<sup>51</sup>, ha anche trattato, in altri saggi contenuti, assieme a quello sull'etica protestante, nel volume *Gesammelte Aufsätze zur Religionssoziologie* (Tubinga, Mohr, 1922), di Confucianesimo e Taoismo, di Induismo e Buddismo, di antico Ebraismo<sup>52</sup>.

Per spiegare il successo dell'economia cinese si fa spesso ricorso al confucianesimo e al principio di ordine, gerarchia, obbedienza che ne derivano, al radicato assenso delle classi subordinate a quelle superiori. In Cina (e con essa in altri Paesi asiatici di cultura confuciana) si è poi fatto leva sugli aspetti della tradizione compatibili con la modernità e ad essa funzionali per il loro sviluppo economico; ne sarebbe derivato un esplicito accordo sociale per realizzare, nelle fasi di transizione, il progresso con tecniche moderne. Il modello confuciano è stato visto come “una lezione per tutti i paesi sottosviluppati del mondo su come uscire dall'arretratezza economica”; una lezione che tuttavia non sembra facilmente assimilabile da parte dei paesi che non hanno quel substrato culturale. Malaysia, Thailandia, Indonesia, Vietnam, Filippine, Laos, Cambogia, Myanmar (Birmania) avrebbero quindi un avvenire più incerto perché “non confuciani” (Corna Pellegrini 1998, P. 111).

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51 Tesi confutate dal Fanfani con un'opera che ha richiamato notevole attenzione anche in campo internazionale, *Cattolicesimo e protestantesimo nella formazione storica del capitalismo*.

52 Il problema si era già posto nell'antichità, quando i cosiddetti imperatori illirici, Aureliano, Diocleziano e Costantino, intrapresero la colossale impresa di restaurare e riorganizzare l'Impero Romano con una politica accentratrice e autoritaria (Luzzatto, 1963, p. 32). Il tentativo ottenne buoni risultati in Oriente, dove il regime dispotico, accentratore e burocratico, di tipo schiettamente orientale si adattava alle abitudini e ai sentimenti di un gran parte della popolazione; in Occidente, al contrario, la pretesa di sacrificare completamente l'individuo allo Stato, di arrivare ad una vera elefantiasi delle funzioni statali, condusse a risultati opposti (Luzzatto, 1963, p. 37).

Gli stessi orientali non sono molto concordi nel valutare l'influenza del confucianesimo sulla società, tanto che all'inizio del XX secolo gli intellettuali cinesi identificavano in esso l'origine della arretratezza del loro Paese (Huntington, 2000, pp. 151 e 153), ed in particolare di quella economica rispetto all'Occidente. Tra coloro che consideravano il confucianesimo come un ostacolo alla modernità e al decollo dell'economia vi è Lu Xun, il più grande scrittore cinese del Novecento che nel racconto *Na Han* (Chiamata alle armi) usò una metafora divenuta famosa per descrivere il torpore culturale del suo paese: immaginò “una casa di ferro senza finestre, indistruttibile, in cui dormono molte persone, condannate a morire per asfissia”. La casa di ferro era il confucianesimo, dal quale lui si augurava che la Cina potesse uscire. La “Chiamata alle armi” era l'appello ai cinesi: svegliatevi che avrete la speranza di uscire dalla casa di ferro. Lu Xun avvertiva che “il richiamo del passato, della sua eredità e della sua ineludibile storia” pesavano ancora molto sulla Cina (Fumagalli 2009, p. 37). Non vi è dubbio che l'insegnamento di Confucio e dei suoi discepoli abbia non poco contribuito a dare rigidità alla società cinese: teorizzando la complementarietà di chi “bene comandando” serve il popolo e di chi, “bene ubbidendo” acquista meriti sociali e personali, ha molto influito nel conservare quasi intatta attraverso i millenni la dicotomia della struttura sociale, con le classi superiori nettamente separate dal resto della popolazione (Corna Pellegrini, 1998, p. 11).

#### Utilitarismo ed economia

In Italia, come in genere nei Paesi occidentali, si sono affermati i principi dell'individualismo, del liberismo, dell'utilitarismo, in aperta polemica con la tradizione medievale dei diritti naturali, che attribuiva a ognuno una collocazione come parte di gruppi organizzati, con obblighi e diritti ben stabiliti. L'utilitarismo è una disciplina che identifica la felicità con l'utilità individuale; la sua formulazione classica risale a Jeremy Bentham, con importanti anticipazioni in Cesare Beccaria. Al suo rapido sviluppo concorse la stretta connessione con l'evolvere della teoria economica moderna, frutto del pensiero occidentale: un legame che cominciò a manifestarsi con la scuola classica. Furono poi i marginalisti e soprattutto Stanley Jevons, Carl Menger e Léon Walras a sottolineare che il comportamento umano consiste in un calcolo razionale mirante a rendere massima l'utilità.



## La diversa concezione del diritto

Diversa è, nei due Paesi, la concezione del diritto, elemento fondamentale per lo sviluppo economico. In Italia, come in tutte le democrazie occidentali, liberismo (economico) è venuto prima del liberalismo (politico); per creare un sistema di mercato ben funzionante infatti lo Stato deve rispettare alcuni diritti individuali basilari, quali l'uguaglianza di fronte alla legge, il diritto di proprietà, la certezza del diritto, che sono parte integrante di un sistema democratico.

Ciò che gli occidentali considerano "diritto" in senso formale è sempre stato estraneo alla Cina, dove il "diritto", fino a qualche decennio fa, era costituito da usi consuetudinari e pratiche rituali, legati alla filosofia confuciana. I primi codici, predisposti all'inizio del Novecento sull'impronta dei modelli occidentali, non entrarono mai in vigore; neppure con la rivoluzione maoista si è voluto sopprimere quel substrato, considerato uno dei caratteri del modello asiatico. La fase attuale è di transizione: accanto alla tradizione si sono introdotte le prime leggi speciali, tra le quali quella sui contratti, e si è predisposto un codice civile. E' quindi difficile, almeno per ora, ascrivere il "diritto cinese" a una delle famiglie dei sistemi giuridici vigenti nel mondo <sup>53</sup>.

Molto spesso ci si interroga sulla relazione che intercorre tra sviluppo economico e regime politico. Il sistema industriale moderno, nato in Inghilterra, si è diffuso negli Stati Uniti, in Australia, in Canada, tutti paesi che condividono regimi liberal-democratici simili a quello inglese. Sul continente europeo tuttavia lo si ritrova, oltre che in Francia, anche in paesi come Germania e Austria-Ungheria, che se ne discostano non poco, per non parlare dell'Impero Russo, dove prima della Rivoluzione di Ottobre l'industrializzazione era già stata iniziata. In tempi a noi più vicini i problemi relativi al legame tra democrazia politica, libero mercato e sviluppo economico si fanno più complessi. Germania, Italia e Giappone tra le due guerre, e poi Taiwan, Corea Meridionale, Singapore, Cina offrono esempi di sviluppo economico accelerato con regimi politici non democratici. La teoria che i regimi autoritari siano più adatti di quelli democratici per promuovere la crescita economica trova il suo fondamento nel fatto che nelle prime fasi dello sviluppo sono necessari, soprattutto da parte delle classi più povere, sacrifici, che difficilmente potrebbero venire accettati in modo spontaneo; una tesi ripresa di recente (ZAKARIA, 2004). In Italia fra il 1860 e il 1880 il processo di accumulazione fu reso possibile dall'accrescimento delle rendite (percepiti dai proprietari terrieri) e dei profitti (di pertinenza degli imprenditori) mentre i salari e il potere di acquisto delle masse rurali rimanevano stazionari. Una soluzione che certo

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<sup>53</sup> LUIGI MOCCIA, *Il diritto in Cina. Tra ritualismo e modernizzazione*, Torino, Bollati Boringhieri, 2009, pp. 258, euro 25,00

non risponde ai principi di equità, ma che sicuramente garantisce l'efficienza del sistema e che è stata possibile in un periodo storico in cui l'elettorato era limitato a un numero ristretto di elettori censitari (Salvatorelli 1971, P. 61).

### Il problema del Mezzogiorno in Italia

Lo sviluppo economico italiano è cominciato nel Nord-Ovest (il "Triangolo" Milano-Torino-Genova) per poi estendersi al Nord-Est e a parte del Centro (Marche e Toscana) ma senza arrivare al Mezzogiorno il cui distacco dal Centro-nord cresce anziché ridursi.

Alla base del problema del Mezzogiorno italiano vi è senza dubbio la "fatalità geografica" che riguarda sia la posizione – la lontananza dai Paesi europei più avanzati, con i quali il Nord invece era, ed è, in contatto - che l'orografia. Una rete idrica assai irregolare, il regime torrentizio dei fiumi, la scarsità delle aree pianeggianti (il 18,3% al Sud e il 34,95 al Nord), la natura argillosa o pietrosa delle montagne hanno fatto sì che solo nella pianura irrigua padana si potesse formare un surplus di capitale agrario da investire nell'industria (la cosiddetta accumulazione primitiva teorizzata da Marx). Né il Mezzogiorno può sperare di raggiungere un alto grado di benessere grazie all'agricoltura e alle attività terziarie come avviene in Danimarca e in talune regioni agricole degli Stati Uniti, perché il rapporto tra spazio e popolazione è sfavorevole e lo sviluppo dell'agricoltura incontra i limiti dati dalla geografia<sup>54</sup>.

Riduzione del divario e tasso di sviluppo. Negli anni cinquanta del secolo scorso molti pensavano che si dovesse ridurre il divario del Mezzogiorno con il resto del Paese. Si trattava, in realtà, di una illusione: ad un saggio nazionale di incremento del PIL (allora) del 5%, per raggiungere l'obiettivo in venti anni sarebbe stato necessario un aumento annuo nelle regioni meridionali del 7,6%. Cosa impossibile, sia perché per ragioni geografiche (ma anche storiche e sociali) lo sviluppo aveva luogo nel Nord-ovest, sia perché lo sviluppo stesso esercitava una funzione fortemente polarizzante, con migrazioni e trasferimenti di capitali.

Nell'ipotesi che nel prossimo ventennio l'Italia abbia un incremento dell'1% annuo, il tasso necessario al Mezzogiorno per eliminare il divario sarebbe del 3,6%. Un tasso certo elevato data la crescita limitata del paese e il processo di terziarizzazione che arresta la parziale industrializzazione del Sud; vi sarebbe tuttavia il vantaggio della mancanza dell'effetto polarizzante di aree in rapida crescita. Se per il periodo si ponesse l'obiettivo più modesto di ridurre della metà il divario, la crescita necessaria per il Mezzogiorno sarebbe del 2,5% circa.

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54 Alberto Ronchey, *Accadde in Italia 1968-1977*, Milano, Garzanti, 1977, pp. 60-63.

Il ruolo delle infrastrutture. Per molto tempo si pensò che il problema del Sud fosse anzitutto una questione di infrastrutture. È certamente vero che in generale le infrastrutture sono, assieme al lavoro e al capitale, uno dei fattori dello sviluppo economico e industriale, che dipende da esse soprattutto per i trasporti, l'energia, le comunicazioni. L'esperienza mostra tuttavia che il rapporto tra infrastrutture e sviluppo non è univoco. Le infrastrutture sono una causa necessaria ma non sufficiente: se non vi può essere sviluppo senza infrastrutture non è altrettanto vero che le infrastrutture, con la loro stessa presenza, diano senz'altro luogo allo sviluppo. La correlazione fra i due è poi tutt'altro che stretta: vi sono infatti casi di aree economicamente sviluppate che dispongono di infrastrutture giudicate insufficienti e dove le stesse vengono costruite per la pressione degli operatori. Al contrario non sono pochi i casi in cui le dotazioni di infrastrutture corrispondono a livelli di sviluppo modesti.

#### Regioni costiere e regioni interne in Cina

A differenza dell'Italia, dove Nord, Centro e Sud sono relativamente equilibrati sia per quanto riguarda la superficie che la popolazione, le otto regioni costiere più sviluppate della Cina (Guangdong, Shandong, Liaoning, Fujian, Zhejiang, Beijing, Tianjin, Jiangsu) hanno complessivamente una superficie di 757.400 chilometri quadrati, pari al 7,88% della superficie complessiva della Cina di 9.572.900 chilometri quadrati.

All'estremo opposto le regioni meno fortunate, Tibet, Xinjiang, Qinghai, Ningxia e Gansu a ovest e Guizhou e Guangxi a sud, che un quarto di secolo fa l'Economist definiva "China's badlands" e che hanno una superficie complessiva di 4.416.400 chilometri quadrati, pari al 46% della superficie totale nazionale.

Nel nord-est un caso particolare è costituito dalle tre province di Liaoning, Jiling e Heilongjiang, note all'estero come Manciuuria (da dove è venuta la dinastia Qing (1644-1911) e per i cinesi come *dongbei* (letteralmente la terra oltre la Muraglia) che ancora qualche decennio fa con una popolazione pari al 10% del totale nazionale aveva una produzione manifatturiera del 15%, quota che saliva al 20% nel caso dell'industria pesante. Ricche di materie prime quali il petrolio e carbone, furono scelte per installarvi l'industria pesante; la successiva riduzione delle risorse naturali e l'obsolescenza delle industrie pesanti ne ha fatto un'area depressa. Non mancano i tentativi per uscire da questa situazione: in particolare nel Liaoning si investe nei settori ad alta tecnologia e si registrano insediamenti di imprese quali la Toshiba, la HP, la Panasonic, la Mitsubishi, la Sanyo, la Siemens Fumagalli 2009, p. 116). A differenza delle regioni occidentali, il cui problema, il sottosviluppo, è analogo a quello

del Mezzogiorno italiano, le tre province del *dongbei* sono diventate regioni depresse, un caso molto simile a quello che qualche decennio fa si era presentato in alcune regioni della Gran Bretagna.

Per molto tempo l'industria manifatturiera cinese ha potuto contare su un bacino pressoché illimitato di manodopera a basso costo, ma la situazione sta ormai cambiando rapidamente. È questo un argomento che merita particolare attenzione perché in Cina l'aspetto geografico, che il Lewis, nel suo celebre saggio aveva lasciato in secondo piano, assume notevole importanza a causa delle dimensioni, della concentrazione dello sviluppo economico nelle regioni costiere orientali, della distanza che separa le aree meno fortunate da quelle sviluppate. Ne è prova il fatto che contadini delle regioni occidentali dell'interno, che in una situazione diversa potrebbero ancora costituire mano d'opera aggiuntiva per l'industria, sono scoraggiati dal trasferirsi a migliaia di chilometri di distanza.

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**RELAZIONI MARITTIME FRA CINA E ASIA SUD ORIENTALE: LE  
TESTIMONIANZE STORICHE DI HOI AN (VIETNAM)**

Introduzione

La dimensione continentale della Cina è stata quella maggiormente riconosciuta e valorizzata a livello storico e geografico, ma accanto a questa rivestono notevole interesse anche le relazioni marittime che, in vari periodi storici, hanno collegato le coste cinesi-specialmente quelle delle provincie meridionali a sud della foce del fiume Yangtze- con le penisole ed arcipelaghi dell'Asia sud-orientale. Si deve rilevare, in generale, che a periodi d'apertura si sono alternate fasi di chiusura verso i traffici marittimi della Cina (come pure del Giappone e della Corea) ma anche in questi momenti le relazioni hanno trovato altri approdi ed altre forme, come quelle d'intense migrazioni di cinesi, che si sono insediati, in via provvisoria o definitiva, nei paesi del Sud est-asiatico.

Questo contributo intende indagare su alcune caratteristiche del contesto marittimo fra la Cina e l'Asia sud-orientale, per cui alcuni studiosi hanno utilizzato anche la metafora di "mediterraneo asiatico". Il periodo d'interesse è quello della prima età moderna, e il caso di studio, da cui osservare tali processi, è costituito dalla cittadina del Vietnam centrale, Hoi An (chiamata allora *Faifo* dagli europei) che è stata, fra XVI e XVIII secolo, un nodo di scambi fra la Cina, il Giappone e l'Asia sud orientale e in cui i portoghesi furono autorizzati a commerciare. Hoi An è particolarmente interessante perché oggi conserva la struttura urbana risalente a quel periodo e ci documenta le relazioni fra varie componenti etniche della popolazione, evidenti ancora nel paesaggio urbano. Proprio per questo è stata dichiarata patrimonio dell'umanità da parte dell'UNESCO nel 1999, ed è divenuta una meta del turismo culturale in Vietnam.

La Cina e l'Asia sud-orientale nella prima età moderna

Il concetto di "mediterraneo asiatico", è stato utilizzato da vari studiosi per indicare le relazioni marittime fra le coste continentali e le isole e arcipelaghi che si affacciano sul Mar cinese orientale e su quello cinese meridionale (detto anche mare orientale). Il termine non si riferisce tanto ad analogie geografico - fisiche, giacché esistono importanti differenze di dimensioni e ambienti fra il mare

Mediterraneo e il contesto marittimo asiatico. Il paragone è invece utilizzato per indicare le relazioni, che in vari momenti storici sono state portate avanti attraverso una rete di centri costieri interessati da scambi, oltre che da regole comuni. Si tratta quindi di una metafora che si riferisce particolarmente al Mar cinese meridionale (fra Cina, Indocina, Indonesia, Filippine e Malesia.)<sup>55</sup>. Su quest'area, che era chiamata dai cinesi il *Nanyang* (mari del Sud), confluirono anche le rotte interessanti il Giappone meridionale, attraverso le isole Ryukyu e Kyushu, dove il porto di Nagasaki fu per secoli l'unico avamposto dei commerci nipponici.

Gli spostamenti via mare, fino all'avvento della navigazione a vapore, erano governati dai monsoni che, per la loro periodicità, hanno favorito e cadenzato i tempi delle relazioni e degli scambi. All'inizio dell'anno ci si spostava dalla Cina all'Asia sud orientale, con il favore dei venti di nord-est, mentre da giugno in poi si andava in direzione opposta, con il monzone estivo di sud-ovest (Gipouloux, 2009, p.128.).

Le motivazioni per gli scambi erano di natura ecologico-ambientale, perché si voleva arrivare ai prodotti tropicali del sud, le spezie in primo luogo, scambiate con i manufatti di ceramica e di seta provenienti dalla Cina. Anche le materie prime minerarie, fra cui l'oro e soprattutto l'argento, divennero sempre più importanti nel corso dei secoli dell'età moderna; provenivano dal Giappone, ma poi soprattutto dalle Americhe attraverso le rotte fra Acapulco e Manila in mano agli Spagnoli. Erano percorse una volta all'anno nelle due direzioni dal famoso galeone di Manila, operativo fra 1593 e 1813 (Idem, p.148.)

Un'intensificazione delle relazioni fra Cina continentale e Asia sud-orientale si ha fra XIV e XV secolo, periodo che è considerato l'inizio "dell'età del commercio" in quest'area, con le eccezionali aperture internazionali dei primi imperatori Ming, contrassegnate dalle spedizioni e dai viaggi guidati dall'ammiraglio Zheng He, per conto della corte imperiale<sup>56</sup>. Si trattava d'iniziative diplomatiche ed economiche dirette dalla Cina ai regni presenti nell'area, improntate al sistema dei tributi con cui i sovrani locali, che entravano nell'orbita di relazioni pacifiche con il celeste impero, erano accreditati all'invio di "missioni" tributarie costituite dai loro prodotti tipici, come i chiodi di garofano, la noce moscata e le spezie (Reid, 1990). L'importanza di questi scambi è data, per esempio, dal fatto che alcuni dei beni più scambiati nel XV secolo, come il pepe ed il legno di sandalo, divennero di larga diffusione nella Cina continentale, tanto da essere usati come parte della paga dei soldati (Idem,p.5).

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55 Questo paragone fra l'Asia sud-orientale ed il Mediterraneo, risale agli anni 1930, ed è stato ipotizzato da vari studiosi europei, in primo luogo olandesi, francesi, anglosassoni (Gipouloux, 2009, p.1-2).

56 Durante i sette famosi viaggi, la flotta delle giunche cinesi, accompagnata dalla grande "nave del tesoro", raggiunse anche le coste dell'Africa orientale fino all'odierno Mozambico (Marchi, 2009b,p.24 sgg.). Le attività marittime cinesi si erano già sviluppate in epoche precedenti (dal X secolo) durante le dinastie Song e Yuan, come si deduce anche dai racconti di Marco Polo (Curtin, 1999,p.131).

Fra le zone interessate dagli scambi, c'era anche il regno Champa, nel centro del Vietnam, dove è localizzata la città di Hoi An, di cui parleremo in seguito. Oltre agli effetti commerciali queste missioni portarono anche all'insediamento di mediatori culturali sino-asiatici.

Uno degli eventi della storia cinese, che ha suscitato maggiori interrogativi storiografici<sup>57</sup>, è la messa al bando dei traffici marittimi decretata dagli imperatori Ming nel 1433, con cui si proibirono sia le missioni portate avanti sotto l'egida imperiale, che i commerci privati. Per mantenere le comunicazioni fra il nord e il sud del paese, era stato attivato il grande canale imperiale, la via d'acqua interna che costituirà l'asse di collegamento fra Hangzhou e Pechino<sup>58</sup>. I territori della Cina meridionale costiera, però, risentirono particolarmente della proibizione. Le città portuali a sud della foce dello Yangtze<sup>59</sup>, che erano state protagoniste dei traffici marittimi, soffrirono sia per la riduzione delle loro attività, sia per la mancanza di sicurezza contro gli attacchi dei pirati, perché erano state smantellate le difese costiere. Il declino economico ebbe come conseguenza la riduzione della popolazione e l'avvio di movimenti migratori diretti verso l'Asia sud-orientale (Skinner, 1985, p.276-7.); un flusso di persone che, alimentatosi a periodi alterni nel corso dei secoli successivi, ha portato oggi alla presenza nell'area di una popolazione di circa venticinque milioni di abitanti di origine cinese (Chin, 2000, p.3.).

Sarà proprio per rispondere alle rimostranze delle province meridionali dell'impero, che si attuerà un rallentamento delle proibizioni agli scambi marittimi di privati fra la Cina e l'Asia orientale nel 1567. Questi provvedimenti non interessarono i rapporti con il Giappone, verso cui l'Impero di mezzo aveva bandito ogni scambio dal 1557 (Diffie-Winius, 1985, p.462). In questo paese, dopo un periodo di guerre intestine, bisognerà attendere l'epoca Tokugawa all'inizio del XVII secolo, per provvedimenti di apertura verso l'esterno, con la concessione di permessi ai commercianti.

Intanto, nel XVI secolo, sui mari della Cina erano comparsi gli Europei, in particolare i Portoghesi, che avevano conquistato Malacca nel 1511, controllando così lo stretto omonimo. Negli anni successivi essi operarono come mediatori nei commerci fra le varie parti dell'Asia orientale e sud orientale, dal loro avamposto di Macao, dove nel 1557 avevano ottenuto la possibilità di insediarsi, dopo i

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57 In genere si fa riferimento alle necessità di difesa del confine terrestre settentrionale che hanno spinto gli imperatori a concentrare là tutte le risorse, oppure alla minaccia costituita dalla casta degli eunuchi, a cui era attribuito il comando delle spedizioni marittime. Infine, si richiama un più ligio rispetto dell'ideologia confuciana, che attribuisce maggiore importanza alle funzioni organizzative dello stato, piuttosto che alle attività commerciali.

58 Il canale, lungo 1.700 km, era costituito da vari tratti, esistenti anche in precedenza. Nel 1415 gli fu assegnata la funzione di trasportare l'approvvigionamento dei grani dovuti come tributi alla corte imperiale di Pechino. Inoltre necessitò di rifacimenti e miglioramenti continui, per garantire il livello d'acqua necessario alla navigazione. Questi si protrassero, nell'arco di circa 3 secoli, fino al tardo XVII secolo (Cheung, 2008)

59 Il sud della Cina risentì anche della perdita di ruolo politico per il trasferimento della capitale da Nanchino a Pechino, completato dai Ming nei primi decenni del XV secolo. Per il caso del porto di Shanghai, cfr (Marchi, 2008, p.102 sgg.)

falliti tentativi di stabilirsi a Canton, nei primi decenni del secolo. Anche il Giappone, raggiunto dai Portoghesi nel 1543, e soprattutto il porto di Nagasaki, in cui si stabilirono nel 1571, fu inserito nella rete degli scambi (Diffie-Winius, 1985, p.463). Al seguito dei Portoghesi s'imbarcarono i missionari, in particolare i gesuiti che iniziarono con successo la loro opera di evangelizzazione, specialmente in Giappone e in Vietnam. Gli Spagnoli, poi, fecero la loro comparsa nell'area con la presa di Manila nel 1571 (Skinner, 1985, p.278).

È in questo contesto storico che si sviluppa la cittadina di Hoi An, nel centro del Vietnam, di cui parleremo nei prossimi paragrafi.

### I commerci internazionali a Hoi An (XVI-XVIII secolo)

Hoi An si trova alla foce del fiume Thu Bon, a circa 4 km dalla costa del Mar cinese meridionale (o mare orientale) nel Vietnam centrale, in pieno ambito tropicale umido, a circa 16° di latitudine Nord. Questa zona, a sud dell'attuale porto di Da Nang e della città imperiale di Huế<sup>60</sup>, è interessante per la storia della penisola indocinese, perché qui, a cominciare dai primi secoli della nostra era, si sviluppò il regno dei Cham (Champa), una popolazione di origine malese, profondamente influenzata dalla cultura indiana<sup>61</sup>. Attorno alla metà del XV secolo quest'area è conquistata dai Vietnamiti provenienti da Nord e nel secolo successivo il Vietnam, pur formalmente sotto il regno di un unico sovrano della dinastia Le, è diviso fra le aree d'influenza di due feudatari, i signori Trin a nord e Nguyen a sud. Sarà l'attività diplomatica di questi ultimi verso i portoghesi e i giapponesi, finalizzata ai loro interessi politici e militari, che favorirà lo sviluppo del porto commerciale di Hoi An.

La prima descrizione di quest'area da parte di Europei si deve a un gesuita italiano, padre Cristoforo Borri, milanese, che vi soggiornò, nel primo decennio del XVII secolo<sup>62</sup>. La sua relazione pubblicata in italiano nel 1631 e tradotta in varie lingue, racconta le vicende d'evangelizzazione nella terra di Cocincina, come fu chiamata la parte centro-meridionale dell'attuale Vietnam. I Gesuiti, infatti, vennero in quest'area a seguito dei Portoghesi, dalla base di Macao, e ottennero un'iniziale accoglienza favorevole da parte dei governanti e della popolazione locale. Accanto all'intermediazione

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60 Che sarà scelta come capitale del Vietnam all'inizio del XIX secolo, con l'unificazione del paese da parte della dinastia Nguyen.

61 Le rovine degli edifici in mattoni del santuario di My Song, nei pressi di Hoi An, testimoniano questa cultura.

62 Sulla figura di Borri, che fu docente di matematica e poi seguace delle idee di Galileo, cfr (Surdich, 1976, pp. 69-122). In questo testo è anche riportata una versione manoscritta della Relazione, poi stampata, che differisce in alcune parti da quest'ultima. Ad Hoi An nei primi decenni del XVII secolo venne anche Alexander De Rhodes, a cui si deve la trascrizione alfabetica della lingua vietnamita, con la pubblicazione di un Vocabolario Vietnamita-Portoghese-Latino, nel 1650 (Nguyen, 200, p.87).



commerciale i lusitani ebbero parte attiva anche nel trasferimento di missionari e di convertiti al cristianesimo dal Giappone, quando da qui cominciarono a essere cacciati alla fine del XVI. Tra l'altro erano cristiani molti mercanti giapponesi.

Nella Relazione di Borri è evidenziata anche la ricchezza dei prodotti della terra e dell'ambiente tropicale, i costumi delle popolazioni locali, fra cui l'uso degli elefanti come mezzo di trasporto, che suscita l'ammirazione e la meraviglia del cronista. Un aspetto rilevante che l'autore rende evidente è il favore del sovrano nell'attrarre commercianti stranieri. In particolare la città di Hoi An, che gli europei chiamavano Faifo<sup>63</sup>, è presentata come il porto principale in cui avvengono gli scambi fra molti stranieri, specialmente cinesi e giapponesi, che vi tengono una fiera "che ogni anno si celebra ... e dura quattro mesi incirca" (Borri, 1631, p.96), cioè l'intervallo fra il monsone del nord e quello del sud. Le merci principali che si scambiano sono costituite soprattutto dall'argento giapponese e dai vari tipi di seta cinese.

La città è collocata a poca distanza dal mare, presso la foce di un fiume che termina attraverso due rami, usati per l'approdo delle navi.

"Quivi fu già dal re della Cocincina concesso un sito proprio ai Giapponesi e Cinesi, per fabbricarvi una città per comodità maggiore della suddetta fiera: chiamasi questa città Faifo. Ed è così grande, che ben possiamo dire che siano due, l'una dei Cinesi, l'altra de' Giapponesi, già che vivono appostati gli uni dagli altri, hanno ciascheduno li suoi Governatori distinti e vivendo li Cinesi secondo le leggi proprie della Cina e li Giapponesi secondo quelle del Giappone" (Ibidem, p.98.)

Ed effettivamente per la congiuntura storica favorevole, che vedeva il rallentamento delle proibizioni cinesi e giapponesi ai commerci esteri, in questo periodo Hoi An fu il porto più favorito per gli scambi. Infatti, fra 1604 e 1622, le navi giapponesi vi giunsero in maggior numero (69) rispetto ad altre destinazioni, come Luzon, la Thailandia, la Cambogia, Macao e il Tonchino (verso cui furono spedite rispettivamente 49, 40, 28, 21 e 20 navi) (Dror-Taylor, 2006, p.16). Contemporaneamente, proprio per la posizione geografica favorevole della costa del Vietnam centrale, gran parte delle giunche autorizzate al commercio marittimo dai porti cinesi del Fujing furono dirette a Hoi An, oltre che a Manila (circa 17 all'anno verso entrambe le direzioni)(Reid, 1990, p.10).

La situazione internazionale si modifica attorno alla metà del Seicento. I Giapponesi espellono definitivamente i cristiani, e con essi i Portoghesi da Nagasaki, nel 1636-39; contemporaneamente

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63 Come risulta dalla cartografia europea coeva si hanno vari nomi, fra cui Haifo, Faifo, effetto di diverse trascrizioni fonetiche del nome locale *Hai Pho* cioè città costiera.

sono proibiti severamente i viaggi all'estero dei Giapponesi stessi. Sarà l'editto di chiusura (*sakoku*) che resterà in vigore per oltre due secoli. Per l'ultima parte del XVII secolo solo gli Olandesi- che si presentavano in Oriente meno interessati al proselitismo religioso-, ebbero la possibilità di mantenere un presidio commerciale sull'isola di Dashima, di fronte alle coste di Nagasaki. Anche in Cina le tensioni interne che portarono alla sconfitta dei Ming e all'ascesa della dinastia dei mancesi Qing nel 1644, ebbero effetti di chiusura, in particolare per contrastare i ribelli fedeli ai Ming rifugiatisi sull'isola di Formosa; la riapertura degli scambi si ebbe solo nel 1685, dopo la loro sconfitta (Gipouloux, 2009, p. 128).

Anche i signori Nguyen cominciarono a considerare il cristianesimo come una minaccia alla coesione sociale basata sulle tradizioni confuciane, e nel 1664-65 radunarono ad Hoi An tutti i cristiani: giapponesi, cinesi ed europei. Un terrore bianco si diffuse nell'area, molti furono giustiziati e i loro beni confiscati (Nguyen, 2000, p.19). D'altra parte, invece, altri Cinesi, rifugiati provenienti dalla Cina meridionale, si stabilirono in città sostituendosi ai Giapponesi. Hoi An perse poi progressivamente importanza alla fine del XVIII secolo per vari motivi, come l'interramento del suo porto fluviale, l'emergere della vicina Danang, i nuovi assetti geopolitici nell'area. Gli Olandesi, infatti, svilupparono le loro relazioni commerciali specialmente con il Vietnam del Nord, stanti le rivalità esistenti con i Portoghesi (Hoang, 2007). Furono i francesi che riallacciarono nel Settecento i contatti con l'area meridionale del Vietnam, da cui poi partirà la loro colonizzazione a cominciare dalla metà del secolo successivo.

#### Le testimonianze storiche a Hoi An

Il centro storico di Hoi An, è stato iscritto nel 1999 nella lista del patrimonio dell'Umanità dell'UNESCO perché rappresenta un esempio di città commerciale asiatica e un luogo d'interscambio culturale fra varie componenti della popolazione. Uno dei suoi manufatti più significativi è, infatti, un ponte coperto, dalla struttura in legno con annessa una pagoda, che è chiamato ponte giapponese. Nel suo primo impianto, risale al XVI secolo e nel 1719 fu denominato *Lai Vien Kieu* (Ponte degli amici venuti da lontano), mentre l'assetto attuale è quello risultante da vari restauri successivi (Nguyen, 2000, p.13-15). Il ponte serviva per collegare le due rive di un ramo fluviale particolarmente impetuoso durante le piene, e nel contempo separava la parte assegnata ai giapponesi, da quella destinata ai cinesi, lungo l'arteria principale della città. A questa strada se ne aggiunsero altre nei secoli successivi, anche lungo la sponda del fiume, specialmente per effetto di colmate che recuperarono nuovo terreno nel 1841 e nel 1866 (Idem, p.47).

Oggi il centro storico, che ha una dimensione di 30 ettari e di 280 nella zona di frangia, è attraversato da quattro strade parallele al corso del fiume; su queste si affacciano edifici di vario interesse storico-documentale. Si tratta di abitazioni di mercanti, addossate le une alle altre, dalla struttura in muratura e dai tetti di tegole. Il piano terra è destinato alle attività commerciali e sono presenti piccole corti con giardini. Varie travi di legno caratterizzano la struttura interna, mentre le forme del tetto sono diverse a seconda che seguano o no i dettami del *feng shui* cinese (con le falde rialzate, oppure rivolte verso il basso). Alcune varianti su due piani con veranda risalgono al periodo della colonizzazione francese. D'altra parte quasi tutti gli edifici oggi conservati sono datati al XIX secolo (*The nomination*, 1996, Appendix 3A).

Altre costruzioni caratteristiche del patrimonio di Hoi An, sono quelle ad uso pubblico o collettivo per le diverse componenti della popolazione. Molte sono destinate ai gruppi di origine cinese, provenienti da vari ambiti regionali della Cina. Si tratta di Pagode riservate ai culti buddisti o confuciani, oppure di edifici a destinazione comunitaria, simili ad abitazioni, che sono usati come luoghi per il culto degli antenati delle famiglie della città. Architetture pubbliche, dalle facciate molto elaborate, definiscono gli spazi per ritrovi e assemblee, spesso collegati ai luoghi di culto.

Ulteriori manufatti che testimoniano la storia multietnica della città sono le tombe, che hanno diverse forme, a seconda che siano giapponesi, cinesi, vietnamite e occidentali, tra cui si annoverano quelle di tre missionari. Le antiche tombe risalgono al XVII- XVIII secolo, il periodo cruciale dello sviluppo internazionale di Hoi An.

Il patrimonio di Hoi An è costituito dalla cultura materiale, espressa nelle strutture fisiche della città, ma anche dalle forme della cultura immateriale<sup>64</sup>. Entrambe sono state particolarmente rivitalizzate attraverso il turismo. La città, infatti, con circa 83.000 abitanti e 1 milione di turisti nel 2006 (UNESCO, 2008, p. 7 e 47), è divenuta una meta di turismo culturale a livello nazionale e internazionale. Oltre alla riqualificazione del patrimonio abitativo, si è operato anche per valorizzare i sistemi tradizionali di produzione dei manufatti artigianali, per cui troviamo una specializzazione nei villaggi circostanti: a Mac Kim Bong nella carpenteria del legno, a Cham Ha nella produzione di ceramiche, mentre su di un'isola fluviale si pratica l'allevamento delle salangane (*Nomination*, 1996, p. 23). I costumi e le tradizioni locali trovano la loro massima espressione nei rituali e nei Festival, che hanno varie cadenze stagionali, come per esempio l'inizio del calendario lunare. In quelle occasioni si rappresentano forme tradizionali di musica, teatro e giochi folcloristici (*Idem*).

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64 Vari siti asiatici, fra cui quello di Hoi An, hanno portato l'UNESCO a rivedere alcuni aspetti dell'autenticità richiesta, ai fini della tutela e conservazione del patrimonio. Sono stati infatti redatti a questo proposito un "Documento di Nara" ed un "Protocollo di Hoi An", rispettivamente nel 1994 e nel 2000. Quest'ultimo intende richiamare "le interrelazioni fra la conservazione del sito fisico, il patrimonio intangibile ed i paesaggi culturali" (Taylor K., 2004, p.430)

Per mantenere la dimensione di una città settecentesca, l'accesso all'area storica è stato regolamentato, mediante la pedonalizzazione in alcuni orari e giorni della settimana, durante i quali la circolazione è consentita solo alle biciclette. A fini turistici, ma anche per rinsaldare i legami comunitari fra le varie generazioni, è stato creato un Festival delle lanterne, oggi divenuto famoso. Si tiene il 15° giorno di ogni mese lunare ed è destinato a ricreare una visione idealizzata del passato della città. Per quel giorno, gli artefatti della modernità, come le luci elettriche e le televisioni, sono spenti negli spazi pubblici e ci si affida solo alla luce delle candele protette da lanterne di carta. Anche la vendita di prodotti turistici è ristretta ad alcune merci. Questo evento ha dato origine a nuove attività manifatturiere, come la produzione di lanterne, che si è aggiunta ad altre, come quelle dei tessuti e confezioni di seta, sviluppate in relazione all'afflusso turistico (Di Giovine, 2009).

#### Considerazioni conclusive

La città di Hoi An, come si è visto, rappresenta un'importante testimonianza delle reti commerciali, attive nella prima età moderna fra la Cina e l'Asia sud-orientale, e conferma l'importanza delle relazioni interasiatiche durante questa "prima globalizzazione". Si trattava specialmente di scambi fra manufatti cinesi, materie prime giapponesi e spezie, provenienti dell'Asia sud orientale, cui si aggiunsero i prodotti locali e quelli provenienti dal resto del mondo, portati dagli europei. Fino a qualche decennio fa, l'attenzione degli studiosi aveva messo in rilievo quasi esclusivamente l'espansione europea e i suoi primati nel contesto asiatico. Come hanno dimostrato le indagini più circostanziate, invece, le relazioni economiche con l'Europa costituirono solo una parte di quelle totali, almeno fino ai primi decenni dell'Ottocento, quando ci fu un cambiamento radicale nell'area. Qui dunque si deve parlare più utilmente d'interscambi euroasiatici, piuttosto che di egemonia europea, nei secoli considerati (Gunn, 2003, Gipouloux, 2009).

La città vietnamita costituisce anche un esempio di un nuovo modello urbano storico, che si è sviluppato in Asia orientale nella prima età moderna. Si tratta di un centro costiero basato su un'economia commerciale, che si differenzia dalla città regale e imperiale, la cui importanza esclusiva è fatta risalire a epoche precedenti (Lombard, 1970). Il crescente rilievo della dimensione degli scambi si riscontra anche in città preesistenti, come nel caso di Hanoi, l'attuale capitale del Vietnam, che nel corso dei secoli XVII-XVIII è descritta dagli europei per i suoi quartieri commerciali lungo il fiume, piuttosto che per la sua retrostante cittadella imperiale (Marchi, 2008, p.174) .

Hoi An corrisponde, inoltre, a un modello urbano di relazioni territoriali, che è stato definito in

termini di “arcipelago” in quanto è diffuso in alcune zone costiere del sud della Cina, del Vietnam, e delle isole nell’Asia sud-orientale. Si tratta di città localizzate in strette pianure costiere, collegate al corso di fiumi e sovrastate da rilievi, per le quali nella storia sono state più facili le comunicazioni via mare, piuttosto che quelle via terra (Wheeler, 2003).

La relativa conservazione del patrimonio culturale materiale e immateriale della città, ci permette, poi, di osservare le interazioni culturali e spaziali del mondo degli scambi, e le relazioni fra la città e i villaggi limitrofi, che è una caratteristica comune ad altre zone del Vietnam (Marchi, 2009a), e all’Asia orientale più in generale.

Hoi An, infine, è oggi un esempio positivo per gli effetti indotti dal turismo culturale. Nella cittadina “addormentata” sui ritmi della risicoltura, la valorizzazione del passato e l’afflusso degli ospiti hanno portato allo sviluppo di nuove attività economiche, con il miglioramento dei redditi e delle condizioni di vita della popolazione residente. La gestione degli impatti negativi sulle risorse naturali e la conservazione delle specificità culturali, tuttavia, costituiscono le nuove sfide che la città deve affrontare, per garantire una sostenibilità a più lungo termine delle attività turistiche stesse.



Fig.1-Localizzazione di Faifo, al nord della Cocincina. Particolare della carta dell’Asia di G. De L’Isle, 1700 circa.

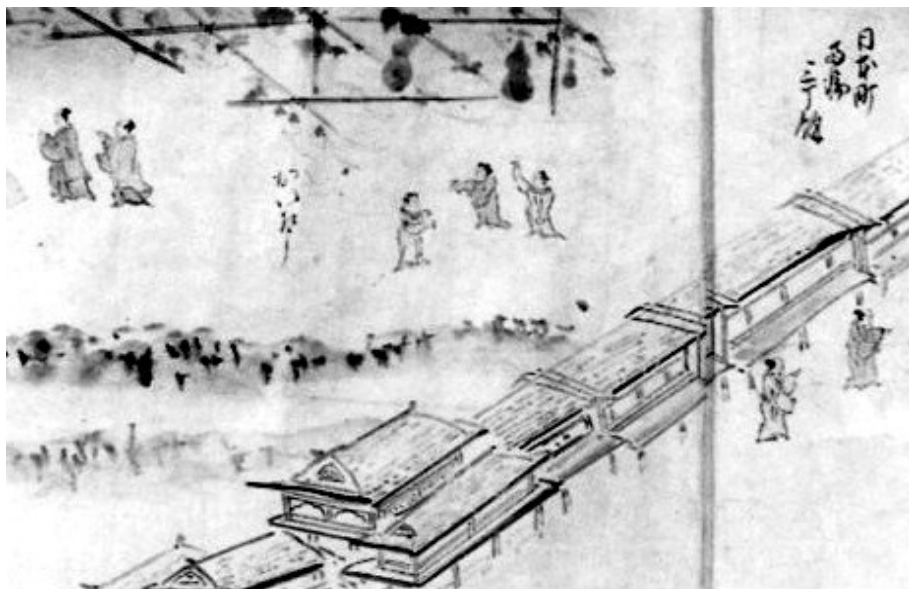


Fig.2-Il quartiere giapponese di Hoi An: pittura della famiglia giapponese Chaya ( XVII secolo),  
in :Wikipedia Commons



Fig.3-Hoi An, il ponte giapponese, oggi  
Foto: M.Marchi

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## **L'ANTICA CARTOGRAFIA CINESE E L'INTEGRAZIONE CON LA CARTOGRAFIA OCCIDENTALE**

I documenti cartografici cinesi antichi sono, purtroppo, abbastanza rari e, oltre ai pochi giunti fino a noi, ne abbiamo notizia attraverso le citazioni e i riferimenti della letteratura geografica cinese, esattamente come è avvenuto per gli antichi documenti cartografici greci e romani in Europa.

I più famosi cartografi cinesi di cui si hanno notizie certe furono Chang Heng (78-139 d.C.) e Pei Hsiu (224-271 d.C.).

Le loro carte sono andate perdute anche se sono spesso ricordate in citazioni bibliografiche.

Anche le conoscenze geografiche fuori dalla Cina dovevano essere notevoli se da una traduzione del gesuita Visdelou, nel 1720, di parte degli annali storici cinesi risulta che nel 166 d.C. un ambasciatore dell'imperatore romano An Tun, ovvero Marco Aurelio Antonino, giunse in Cina.

Quindi i Cinesi conoscevano l'esistenza dell'impero romano che, sembra, chiamassero Ta tsin.

Le prime mappe cinesi, a noi note, sono la "Hua I Thu" del 1137 d. C. e la "Yu Chi Thu" sempre del 1137 d.C., ma incisa su lastra di pietra a Xian.

Entrambe raffigurano l'intero territorio cinese.

La "Hua I Thu" era estremamente dettagliata per quello che riguardava la rete fluviale, mentre era piuttosto approssimata per i contorni costieri. Alternava particolari di grande precisione, come il tracciato della grande muraglia al nord, con soluzioni cartografiche poco comprensibili, come il difficile riscontro della penisola dello Shandong di fronte alla Corea.

La "Yu Chi Thu" manteneva una grande precisione nella rappresentazione della rete fluviale, se possibile anche migliorata rispetto alla carta precedente, mentre il contorno costiero rimaneva impreciso, anche se la penisola dello Shandong era meglio delineata e facilmente identificabile.

Le due mappe sono senz'altro molto antiche e non c'è alcun dubbio sulla loro autenticità, nonostante la curiosa coincidenza della datazione che fa sospettare un'attribuzione di comodo e approssimativa, 1137d.C. per entrambe.

A questo proposito, non trovando obiezioni valide, si ritiene di poter accettare quanto riportato dalle fonti bibliografiche.

Un problema sorge, però, su un altro aspetto di queste due mappe.

In entrambe, il tratto terminale del fiume Hoang Ho (Fiume Giallo), nel nord della Cina, mostra la foce a nord della penisola dello Shandong nel mare di Bohai.

Dallo studio geomorfologico di Liu Cangzi e H.J. Walker, nel 1989, sulle variazioni del corso del fiume e gli spostamenti della foce dal mare di Bohai al mar Giallo, risulta che dal 1128 al 1855, la foce del fiume Giallo era nel mar Giallo a sud della penisola dello Shandong, mentre solo prima del 1128 e dopo il 1855, la foce sarebbe stata a nord della penisola dello Shandong nel mare di Bohai.

Considerata la validità dello studio di Liu Cangzi e Walker, ampiamente documentato da dati geomorfologici, aerofotogrammetrici e storici, e l'impossibilità che le due mappe siano posteriori al 1855, rimane l'unica possibilità che siano più antiche del 1137 e precedenti al 1128.

Forse la differenza di datazione consiste solo in qualche decina d'anni, ma trattandosi di documenti antichi, si ritiene corretto, e non superfluo, cercare riscontri anche in discipline diverse, che permettano una critica costruttiva e una valutazione sull'affidabilità dei dati forniti dalle mappe.

Anche la Cina, come Europa e mondo islamico ha avuto grandi viaggiatori come Marco Polo e Ibn Battuta, ma la loro influenza sulla cartografia non sembra essere stata rilevante.

L'attenzione della cartografia cinese sembrerebbe riservata al solo territorio nazionale.

Ma non sempre è stato così. All'inizio del 1400, la Cina sviluppò una politica di espansione con l'invio di flotte poderose verso l'Asia meridionale, l'Oceano Indiano e l'Africa centro meridionale.

Al comando dell'ammiraglio Zheng He, un eunuco della corte imperiale dei Ming, la flotta cinese compì ben sette spedizioni navali a scopo diplomatico, commerciale e militare toccando porti della Corea, del Giappone, dell'Indocina, dell'Indonesia, dell'India, dell'Arabia e della costa africana fra Somalia e Kenya con probabile arrivo anche in Madagascar.

La flotta era volutamente imponente per mostrare la potenza della Cina : circa 300 navi con 28000 uomini di equipaggio.

Con la morte di Zheng He nel 1434 terminò la politica di espansione commerciale cinese fuori dalla Cina.

La flotta oceanica fu smantellata, la Cina si chiuse in sé stessa e, addirittura, si tentò di cancellare anche la memoria delle imprese di Zheng He.

Fortunatamente alcuni portolani compilati durante i viaggi nell'oceano Indiano erano sfuggiti alla distruzione e furono pubblicati nel 1621 da Mao Yuan I.

Le notizie giunte fino a noi di questa vicenda sono scarse e frammentarie e possiamo solo formulare ipotesi sugli eventi di quel tumultuoso periodo della storia cinese.

Nel 1386 una rivoluzione scacciò la dinastia Yuan, di origine mongola, instaurata in Cina dai discendenti di Gengis Khan e installò al potere la dinastia autoctona cinese dei Ming.

Sotto gli ultimi imperatori Yuan la Cina era decaduta economicamente e si sentiva minacciata dall'esterno.

Al confine sud occidentale Timur Leng (Tamerlano) stava ricostituendo una forte coalizione delle tribù della steppa, cosa questa che la Cina giustamente considerava una minaccia.

Inoltre, come è testimoniato anche nel Milione di Marco Polo, i commerci fra Cina e Occidente erano fiorenti, seguendo la carovaniere della via della seta e le rotte dell'oceano Indiano, ma completamente in mano a mercanti arabi e persiani che avevano, in pratica, il monopolio della navigazione nell'Oceano Indiano dalle coste africane all'India e alla Cina.

I mercanti musulmani, eredi della cartografia e geografia greco-romana, percorrevano il Mediterraneo, facevano incursioni in Atlantico e dominavano le comunicazioni in oceano Indiano sulla rotta delle spezie con l'India e da qui verso la Cina.

In questo contesto, in cui la Cina non gestiva direttamente i commerci con l'occidente, va probabilmente inquadrata la politica di esplorazione dell'Oceano Indiano da parte di Zheng He per cercare di togliere il monopolio commerciale ad arabi e persiani.

Questo tentativo di espansione della potenza politica e commerciale della Cina terminò con la morte di Zheng He.

Le ipotesi possibili su questo brusco cambiamento di politica fanno supporre che all'interno della classe dirigente cinese fosse in corso una lotta tra lobbies dagli interessi diversi per la conquista del potere.

Da un lato la lobby isolazionista di funzionari confuciani, tradizionalisti e contrari ad ogni novità, dall'altro lato la lobby dei mercanti alleata alla lobby militare che caldeggiavano una politica di espansione imperialista verso il mondo esterno alla Cina.

Zheng He era il protagonista che rendeva possibile il successo di questa politica, ma la sua morte fece ripiombare la Cina nel suo tradizionale isolamento.

Sempre durante la dinastia Ming, la presenza in Cina del missionario gesuita Matteo Ricci, dal 1582 alla morte nel 1610, ebbe inaspettata influenza sulla cartografia cinese dell'epoca.

Matteo Ricci, forse per essere più facilmente accettato nell'ambiente cinese, adottò costumi cinesi e svolse negli ambienti di corte un'intensa collaborazione con i dotti cinesi, fornendo loro informazioni scientifiche sul mondo esterno alla Cina.

In questo ambito produsse un planisfero che mostrava la Cina inserita in mezzo agli altri paesi conosciuti.

Conobbe e collaborò con il mandarino Wang Pan , a cui viene attribuita una carta della Cina del 1594 che rientra, anche se migliorata nei dettagli della linea di costa, nella tradizione della cartografia cinese classica.

L'influenza di Ricci sul mondo intellettuale cinese, tradizionalista e isolato per sua scelta dal mondo esterno, fu senz'altro importante, ma non fu il solo motivo di futuro cambiamento.

Infatti l'interesse economico-commerciale delle potenze europee abbinato all'apertura delle vie di navigazione oceanica porta ad una sempre maggior presenza europea in Cina.

La conseguenza nella cartografia fu un graduale e inarrestabile sviluppo della cartografia occidentale nel raffigurare la Cina a scapito delle rappresentazioni cinesi tradizionali.

La carta della Cina del 1519, atlante di Miller, era piena di errori e molto peggiore delle vecchie carte cinesi, sconosciute in occidente, del 1371.

La carta del 1655 di J. Bleau era già una versione accettabile del territorio cinese con alcune inesattezze, dovute a mancanza di dati per quanto riguarda Giappone e Corea, non ancora entrate nell'orbita di influenza europea.

Un esempio di transizione fra cartografia occidentale e cartografia cinese è dato dalla carta che riporta la zona compresa fra la foce del Fiume Giallo a nord e la foce dello Yang Tze Kiang a sud.

Questa carta faceva parte di sette grandi tavole rappresentanti l'impero cinese; fu prodotta dal gesuita Matteo Ripa nel 1718 su incarico dell'imperatore K'ang Hsi (1662-1722).

Le diciture furono stampate in caratteri cinesi con aggiunta di diciture esplicative in italiano.

E' stato forse il primo caso di una carta con caratteristiche miste cinesi ed europee.

Nel XIX secolo si ha una rappresentazione finalmente esatta dell'area cinese. La data non è sempre reperibile sulla mappa, ma è sicuramente antecedente al 1855 perchè è stato solo dopo tale periodo che il Fiume Giallo (Hoang Ho) cambiò corso e invece che nel mar Giallo, come è stato già riportato, andò a sfociare a nord della penisola dello Shandong nel mare di Bohai.

La conclusione è che anche in Cina, come nel resto del mondo, dal 1600 al 1800 la cartografia a carattere locale scomparve gradualmente per lasciare il posto ad un tipo unico di cartografia di impronta europea e non più riservata solo ad addetti ai lavori, ma disponibile ad essere portata a conoscenza di tutti.

## **CAPITOLO 2**

### **Contributi di scienze geofisico-ambientali**

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### **THE STUDY OF ENVIRONMENTAL POLLUTION AT ISMAR-CNR IN BOLOGNA (ITALY)**

#### Introduction

The activity of our group at the Bologna Section of ISMAR has been dedicated over time to promote researches having the object of assessing the quality of a series of aquatic environments (lakes, lagoons, artificial reservoirs, ports, coastal zones, rivers) all over the world (Italy, Vietnam, Morocco and Mexico), based on the study of sediment contamination.

The long lasting collaboration with colleagues from the CNR-Institute for the Dynamics of the Environmental Processes (CNR-IDPA, Venice) and the CNR-Institute for the Coastal Marine Environment (CNR-IAMC, Capo Granitola, TP) has permitted to provide high quality analytical results to our researchers with the use of structures and instruments that can measure organic and inorganic species to trace and ultratrace levels or that permit to process and analyze a large number of samples in short times when high resolution is not required.

Our studies refer essentially to the reconstruction of natural biogeochemical processes and the modifications induced by anthropogenic activities (above all pollution) and climatic changes. In particular, we can define: i) history and trends of contaminant atmospheric fluxes through the sediment records stored in salt marshes; ii) rates of dissolved-particle interaction and particle residence times in the water column based on  $^{238}\text{U}/^{234}\text{Th}$  disequilibrium; iii) particle fluxes through the water column, their variability and transformation during sinking through the use of sediment traps; iv) sediment

and mass accumulation rates and chronologies (with the analysis of  $^{210}\text{Pb}$ ,  $^{137}\text{Cs}$  or other radiotracers); v) bioturbation and the exchange of dissolved species through water-sediment interface; vi) early diagenesis mechanisms; vi) historical reconstructions of sedimentary processes and climate changes through surficial seismic and interpretation of stratigraphic records; vii) chronology of sediment pollution; and viii) mass budgets of chemicals and sedimentary materials. In the last years, our attention has been focused to the implementation of environmental multispecies multicompartiment models that can be used to promote the scientific-sound and effective management of environmental resources.

The main projects developed by this research group over the last decades are described in the selected list of published papers reported below, with a special focus on the most important results obtained so far.

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## **TEMPORAL VARIATIONS OF SEAWATER COMPOSITION OVER THE PAST 150 MILLION YEARS**

Abstract: There is strong evidence that the seawater composition has not been at steady state over geological time scales. Global cycles, such as sea-level changes, the carbon cycle, and seawater chemistry, are assumed to be partly due to temporal variations of the rates of ocean-floor spreading. Several studies have modelled the evolution of seawater composition during Phanerozoic, or have estimated changes from fluid inclusions; from pore fluid chemistry; from marine biogenic carbonates; from ridge flank hydrothermal carbonate veins; and from Mg, B and S isotope composition. While there is disagreement over the causes of seawater compositional changes, there is a general consensus that the Mg and Ca concentration in seawater has varied during Phanerozoic; in particular, that Mg/Ca has risen over the past 80 Ma as a consequence of both an increase of seawater Mg concentration and a decrease of Ca concentration. It appears that the Mg/Ca ratio of the Mesozoic ocean was 3 to 5 times lower than that of modern oceans. River influx from continental weathering; hydrothermal circulation in oceanic basalt; and deposition of dolomite, all affect seawater Ca and Mg content, but fail to explain the Mg/Ca temporal increase. We show here that reactions of mantle-derived peridotites with seawater along slow spreading mid ocean ridges contributed to the post-Cretaceous Mg/Ca increase. The amount of hydration of the oceanic mantle depends directly on the amount of cold fluids brought down into the mantle during hydrothermal circulation at ridges. Serpentinization of the oceanic mantle, in turn, depends on the thermal structure of the ridge, that is strongly influenced by spreading rate and also by rock permeability. Mantle rocks-seawater reactions can release to modern seawater roughly 20% of the yearly Mg river input. A corresponding decrease of hydrothermal seawater/basalt reactions lowers Ca input to and Mg extraction from the ocean. However, no significant peridotite-seawater interaction and Mg release to the ocean occur in fast spreading, East Pacific Rise-type ridges. We modelled the effect on Mg and Ca seawater concentration of (a) variations through time of oceanic crustal production and (b) volume of low-temperature mantle hydration related to changes in spreading rates and accretionary plate boundary geometry. The model calculations are based on recent maps of present day seafloor ages and plate tectonic reconstructions, that established a curve



of seafloor spreading rate and of oceanic crust production rate over the last 150 Ma, suggesting a strong reduction of spreading and crustal production rate since the Santonian , i.e., 83.5 Ma. In fact, the Mesozoic Pangean superocean implies a hot fast spreading ridge system, but near-absence of Atlantic-type intercontinental slow spreading oceans. This prevented peridotite-seawater interaction and Mg release to the Mesozoic ocean, but favored hydrothermal Mg capture and Ca release by the basaltic crust, resulting in a low seawater Mg/Ca ratio.

Model results suggest that three important processes have affected temporal variations of Mg/Ca during the last 150 Ma: (1) hydrothermal circulation in basalts; (2) low-temperature MORP/seawater reactions; and (3) dolomite formation. Given that the calculated oceanic crust production was higher during the Cretaceous than in the Cenozoic, we estimated a greater hydrothermal Mg-uptake by the crust and Ca-release in the Cretaceous than in the Cenozoic. We have shown that Mg-input to seawater due to Mg-release by MORP/seawater reactions was low (less than 4% of the river input) during the Cretaceous and high (up to 20% of the river input) during the Cenozoic. Numerical modelling clearly show that Mg-released by low-temperature MORP-seawater reactions contributed to the sharp increase of seawater Mg-concentration around 70-60 Ma. In addition, we have also shown, from Mg isotope budget constraints, that Mg-capture by dolomite precipitation was higher during the Cretaceous (up to 23% of the river input) than during the Cenozoic (down to 14% of the river input). Continent dispersal and development of slow spreading ridges allowed Mg release to the ocean by peridotite-seawater reactions, contributing to the increase of the Mg/Ca ratio of post-Mesozoic seawater.

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## URBAN VEGETATION AND AIR POLLUTION MITIGATION: HOW PLANTS CAN AMELIORATE THE URBAN QUALITY OF LIFE

### Introduction

Climate change is one of the most challenging environmental, social and economic issue that global society faces. The problem of climate change needs a strategy which aims at integrating both mitigation and adaptation actions. As the global urban population has doubled over the last 50 years and it is estimated that two-thirds of the world's population will be living in cities by 2030, the effects of climate change are becoming even more and more visible, that is not only caused by the enhanced temperatures due to the increasing concentration of CO<sub>2</sub> in the atmosphere but this effects are worsened by air polluting elements, gases and particulates, generated by human activities: vehicular traffic, buildings, industrial processes. Europe is the most urbanized continent of the world and the atmospheric pollution over European cities is an unresolved problem of increasing concern. This environmental problem is also evident in China because of the recent industrial expansion and of the consequent increasing load of anthropogenic pollution.

Urban forestation (namely city parks, urban and sub-urban forests, and green belts around industrial conurbations), offers an undeniable integrated strategy to tackle climate change as it produce both mitigation (through CO<sub>2</sub> and pollutant absorption) and adaptation effects (through a preservation of soils, increasing urban areas resilience to increase temperatures etc...). In addition, the creation of urban green areas helps improving urban environments and the overall quality of life of citizens. An incorrect forest management however may not give all the expected beneficial impacts in the urban environment. In fact, plants emit volatile organic compounds (VOC) which role on determining the formation of smog and tropospheric ozone when interacting with anthropogenic activities has been already recognized. To assess the impact of urban greening initiatives on air quality and ultimately on human health in areas where pollution episodes are common, an appropriate screening and selection of vegetation to be introduced in urban planning require special attention.

## Benefits of investing in urban forestation

Urban forests have received increasing attention as an efficient abatement strategy for reducing air temperature, greenhouse gases, as well as photochemical air pollutants and for improving air quality (see Niinemets and Penuelas, 2008).

### Urban heat island

The progressive urbanization with the consequent land use changes associated with the limitation of vegetated areas, have caused cities to maintain higher temperatures than their surrounding countryside. These interactions are mainly based on surface radiation and energy balances that are regulated by the different physical characteristics of the building materials. This increased heat is known as an urban “heat island”. Landersberg (1981) showed that the mean value of heat island is a function of city dimensions and that also a small city can cause air temperature significantly different from countryside. The climatic discomfort in the cities results not only from the overheating, but also from the presence in the urban air of particulates and pollutants derived from anthropogenic activities. The combined effect of heat stress and air pollution increased morbidity and mortality of the local community. The inclusion of greenery in cities through the implementation of trees can mitigate the urban heat island phenomenon and thus ameliorate microclimate conditions, inducing several benefits such as a sensible temperature reduction. Solar energy can be partially reflected, transmitted and dissipated by the plants as latent and sensible heat and partially used for metabolic processes (photosynthesis). Direct shading, evaporative cooling (transpiration), and photosynthesis allow plants to control surface temperatures and microclimate around buildings.

### CO<sub>2</sub> absorption

The plants are the best organisms able to limit the CO<sub>2</sub> increase by the photosynthetic process, that convert the atmospheric carbon dioxide into organic compounds using the energy from sunlight, and releasing oxygen. All living plants absorbs CO<sub>2</sub> from the atmosphere storing the carbon as biomass, but trees process significantly more than smaller plants due to their large size and extensive root structures. In fact, trees have much more “woody biomass” to store CO<sub>2</sub> than smaller plants, and are considered the nature’s most efficient “carbon sinks.” The ability of plants to absorb CO<sub>2</sub> depends also on light, temperature, total leaf surface and growth rate. The CO<sub>2</sub> uptake is different by different

species and some are better than others. For instance, willow, larch, poplar and birch are considered more efficient on CO<sub>2</sub> sequestration compared to oaks, field maple, English elm and hazel (<http://www.es.lancs.ac.uk/>).

### Gas pollutant absorption

The urban environment contains a complex mixture of air pollutants, the exact composition of which varies both over time and between individual towns and cities due to changes in patterns and sources of emissions. In terms of their high concentrations in exhaust emissions, nitric oxide (NO) and nitrogen dioxide (NO<sub>2</sub>) are the most important phytotoxic pollutants associated with road transport. During combustion, other pollutants, including sulphur dioxide (SO<sub>2</sub>) and volatile organic compounds (VOCs), are emitted, together with carbonaceous particles from incompletely burnt fuel droplets. The plants can act as biological filters; in fact, during daylight hours, leaves emit oxygen and absorb carbon dioxide through the photosynthetic process but, with a similar mechanism, they can also take up pollutant gases such as ozone (O<sub>3</sub>), carbon monoxide (CO), NO<sub>2</sub> and SO<sub>2</sub>). Once these gases are absorbed by tree leaves, they diffuse into intercellular spaces and may be absorbed by water films to form acids or react with inner-leaf surfaces; in these ways they are readily removed from the atmosphere (Nowak, 1999).

Considering that it is unquestionably simplistic the assumption that the stomata area alone is responsible for exchange of gas-phase pollutants, it is thus reasonable to suppose that micro-morphological characteristics of leaves, such as stomata morphology and abundance and cuticle thickness would be among those features capable of affecting a plant's gas-phase pollutant uptake. In designing screening level procedures to predict the pollutant processing potential of various species of plants, morphological attributes of the plants should be among the suite of characteristics to consider (Cornejo et al. 1999).

### Particulate uptake

Trees also remove pollution by intercepting and retaining on the plant surface airborne particles acting as biological filters (Beckett et al. 1998; Yang et al., 2005). The deposition velocities and capture efficiencies of airborne particles by trees depend on meteorological factors, like wind speed (Beckett et al., 2000, 1) and particle diameter (Belotet et al. 1994), and on tree properties, like the anatomy and morphology of the leaves (Beckett et al., 1998) and structure of the canopies (Freer-Smith et al., 2005).

In general, the effectiveness of particle uptake by tree is increased if their leaf surfaces are rough or sticky. In fact, for coarser particles it appears that increased stickiness of the surface facilitates greater particulate capture, whilst for fine particles is the epidermis micro-roughness that greater influence the airborne particles uptake (Chamberlain,1981). Also the dense pubescence is a property suspected of increasing the tree's pollutant capturing ability (Beckett et al., 2000, 2) as well as the presence or absence of wax on leaves.

### Biogenic Volatile Organic Compounds (BVOCs)

An innovative and important aspect that managers of urban areas should considered is related to the potential of vegetation to emit Volatile Organic Compounds in the atmosphere. In fact, biogenic VOCs, mainly isoprenoids (isoprene and monoterpenes), may have a remarkable influence on the composition of the lower atmosphere. But why plants emit VOCs? For many biogenic VOCs, the function for the emitting plants is not entirely clear although the emissions seem to play multiple ecophysiological roles in plant protection, in particular during episodes of high photosynthetic photon flux density, high temperatures, oxidative and biotic stresses.

Besides the ecophysiological functions, BVOCs play a significant role in atmospheric chemistry in particular in the formation or reduction of tropospheric ozone (Fehsenfeld et al., 1992) and in the formation of Secondary Organic Aerosols (SOA; Hoffman et al., 1997). In the presence of sufficient levels of oxides of nitrogen (NO<sub>x</sub>), such as in a urban areas, and sunlight, this high reactivity can induce photochemical formation of ozone and peroxides (carbon monoxide). On the contrary, in less polluted environment such as rural area where the NO<sub>x</sub> concentration is low, these hydrocarbons may actually remove ozone. It is well recognized that BVOCs differ significantly in how rapidly they react in the atmosphere to promote or inhibit ozone formation and that different species of vegetation emit a wide variety of BVOCs. The actual ozone-forming potential (OFP) of a tree species is therefore a function not only of the emissions rates of that tree but also of its hydrocarbon speciation profile and the reactivity of the BVOCs emitted (Benjamin & Winer, 1998). Since the quality and quantity of BVOC emission is species-specific (Ciccioliet al, 2004; Baraldiet al., 2006), it is important to choose the best vegetation to be used in large-scale urban tree planting programs. Thus, the selection of low-emitting trees is critical in polluted urban areas where large-scale tree planting programs are being considered.

All these considerations suggest that the air quality impacts of increased urban tree cover may be locally positive or negative with respect to ozone. While an extensive inventory has been carried

out on emission rates of native emitting species in natural environments, many urban tree species, both naturally occurring and exotic, have not been screened for BVOC emission.

We investigated the effectiveness in carbon sequestration and in leaf BVOC emission capacity from which we derived the ozone forming potential (OFP) of some widespread ornamental broadleaf species (other species are in progress) in order to provide useful information for a correct and innovative management of trees to improve air quality and life conditions in urban environment (Baraldiet al, 2010; Saeboet al., 2012). Some results obtained within the European Life + project GAIA (Green Areas Inner-city Agreement) are reported in (<http://www.lifegaia.eu/IT/index.xhtml>). From our results we found that all the examined species are suited for planting in the urban environment since they are low- or moderate-emitters, with the only exception of the high emitters Liquidambarstyraciflua and Koelreuteriapaniculata for which a limited planting is suggested in polluted environment in order to avoid a high impact on ozone formation. This inventory of carbon sequestration effectiveness and ozone forming potential of the different plant species represents an important tool for large-scale innovative planting programs aiming at the reduction of increasing atmospheric CO<sub>2</sub> concentration and of pollutant episodes.

In a previous research, we conducted a similar survey in the Beijing region to identify plants that emit isoprenoids (Loreto et al., 2002). The emission pattern was similar to that observed in the surveyed boreal ecosystem (Europe, North America), showing that some deciduous oaks are more suitable for the urban environment of Beijing since they do not emit isoprenoids, differently to the majority of the high emitting oaks. Furthermore, some of the bamboo widespread in the city parks and in the riparian vegetation surrounding the city, resulted high isoprene emitters, while *Pinus tabulaeformis*, one of the most important trees in China, is a low emitter compared to other pine species. Other VOC inventories from vegetation in Beijing have been presented (Zhihui W. et al, 2003) showing that BVOC emissions are not very high in this city, but increases in plantation area established with high isoprene emitting species (e.g. *Bambusa* spp. and *Eucalyptus* spp.) projected for China and other parts of Southeast Asia in the next future, will potentially alter the atmospheric chemical composition and air quality over this city and the rapidly developing South Asian regions (Geronet al., 2006).

## Conclusions

Vegetation has been well recognized for its ability in improving air quality and alleviating global warming. The implementation of green technologies can thus contribute to ameliorate microclimate conditions in urban environment. In fact, the benefits of urban forests are not only

relatively on the better beautification of cities, increase in pleasant social and recreational area, but trees have also an important environmental impact. In particular, urban forests have received an increasingly attention in order to develop efficient abatement strategies to alleviate the intensity of heat island, to sequester carbon dioxide and to reduce air pollutants, with the objective of improving air quality. Besides the sink action of trees, another important plant trait that managers of urban areas should consider for the implications on the atmospheric chemistry is related to the potential of the vegetation to emit VOCs and the consequent potential to form tropospheric ozone. As some plant species emit high amount of VOC to the atmosphere, inappropriate plant selection may result in undesirable effects on air quality and human health. In central eastern China, the estimated BVOC emissions are very small, while in North eastern and southern China there are relatively large biogenic emission of isoprenoids leading to an important impact on the ozone production in these regions (Tie X. et al., 2006). Urban greening in China as well as in other European countries has developed in tandem with the evolution of civilization and society. Thus, a responsible choice of the plants to be used in polluted environment where large-scale tree planting programs are being considered, should evaluate the introduction of low-emitting trees and the reduction of high-emitting plant species to alleviate rather than exacerbate the effect of anthropogenic pollution. In fact, the effect of increased vegetation is a decrease in ozone concentrations if the additional trees are low BVOC emitters. Tree planners might keep in mind a simple slogan: “the right tree in the right place”.

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## **DELTA DEL PO, ACQUA COME PATRIMONIO**

La Collaborazione ventennale tra CNR/UNIBO e Accademia delle Scienze Cinese ha permesso, negli ultimi anni, di conoscere più da vicino l’area cinese del Delta del Fiume Giallo, portando ad un confronto con un mondo che vive oggi uno straordinario momento di sviluppo economico e di trasformazione territoriale che interessa spazi sterminati. Una realtà dove, tuttavia, emergono con forza i problemi che tutte le società che sono cresciute e crescono “*usando*” con metodi intensivi le risorse naturali, prima fra tutte l’acqua, hanno dovuto affrontare.

Il peso sempre più rilevante che i cambiamenti climatici rivestono nelle dinamiche ambientali, ma anche sociali ed economiche, del mondo contemporaneo, porta alla necessità di pensare ed elaborare nuove politiche per lo sviluppo e per la gestione delle risorse naturali ed ambientali basate su uno sviluppo sostenibile che parta dalla valorizzazione e dalla tutela dell’ambiente, dalla valorizzazione economica e sociale della realtà territoriale coinvolta e in grado di promuovere attività dinamiche di “autogenerazione” delle risorse.

Tali politiche di sviluppo implicano necessariamente una condivisione degli obiettivi e dei principi posti alla base dello sviluppo.

Le collaborazioni e i momenti di incontro tra Italia e Cina, in questi termini, rappresentano l’occasione per un confronto costruttivo e per una reciproca crescita, sia in campo accademico che operativo, per la gestione e lo sviluppo di tematiche comuni, relativamente alle risorse naturali ed ambientali.

L’argomento principale della presente dissertazione è l’ACQUA, acqua intesa come habitat costieri con le residue “*zone umide*”, acqua in termini di pesca, acquacoltura, turismo e acqua in relazione ai cambiamenti climatici a cui è doveroso adattarsi, senza rinunciare a riorientare le politiche di sviluppo per ridurre la produzione di CO<sub>2</sub>, “*gas alterante*” il clima.

Il Libro Bianco dell’U.E. sull’adattamento ai mutamenti climatici (1) definisce un quadro finalizzato a rendere l’Unione Europea meno vulnerabile di fronte agli impatti dei cambiamenti stessi.

Esso si basa su quattro pilastri:

- costituire una solida base di conoscenze sull’impatto e sulle conseguenze dei cambiamenti climatici;

- integrare l'aspetto dell'adattamento nelle principali politiche dell'UE;
- utilizzare una combinazione di strumenti politico-strategici (tra cui strumenti di mercato e linee guida) per garantire il conseguimento efficace degli obiettivi;
- accelerare la cooperazione internazionale.

Aumentare la resilienza dell'UE ai cambiamenti climatici significa anche investire in un'economia a basse emissioni di carbonio, che promuova l'efficienza energetica e la diffusione di prodotti ecologici.

L'adattamento è fondamentalmente locale, dato che gli impatti dei cambiamenti climatici variano da regione a regione, ma è altresì una sfida di ampia portata, in quanto la necessità di adattarsi ai cambiamenti climatici è condivisa dalla maggior parte dei processi naturali e delle attività umane.

La Direzione Generale *“Azione per il clima”* sta lavorando con altri servizi della Commissione Europea per individuare le misure qualitative concrete da mettere in atto, lavoro che porterà nel 2013 ad una strategia di adattamento climatico. Uno dei temi centrali è la politica in materia di acque, e si sta provvedendo ad introdurre nel piano per la salvaguardia delle risorse idriche europee elementi relativi alle esigenze di adattamento.

In questo senso, ed in coerenza con quanto previsto dalle linee politiche strategiche in corso di elaborazione a livello europeo, l'Ente di gestione per i Parchi e la Biodiversità - Delta del Po, si è impegnato concretamente, nel corso degli ultimi anni, proponendo, attivando e partecipando a diversi progetti di livello europeo con lo scopo principale di approfondire, analizzare ed intervenire sul territorio definendo nuove politiche strategiche di intervento, elaborando progetti di riqualificazione e valorizzazione e perseguendo obiettivi di sviluppo sostenibile prestando particolare attenzione alle nuove esigenze naturali, ambientali, paesaggistiche e climatiche.

Diversi progetti hanno impegnato il Parco sui temi dell'acqua, tra questi, quelli in corso sono tre:

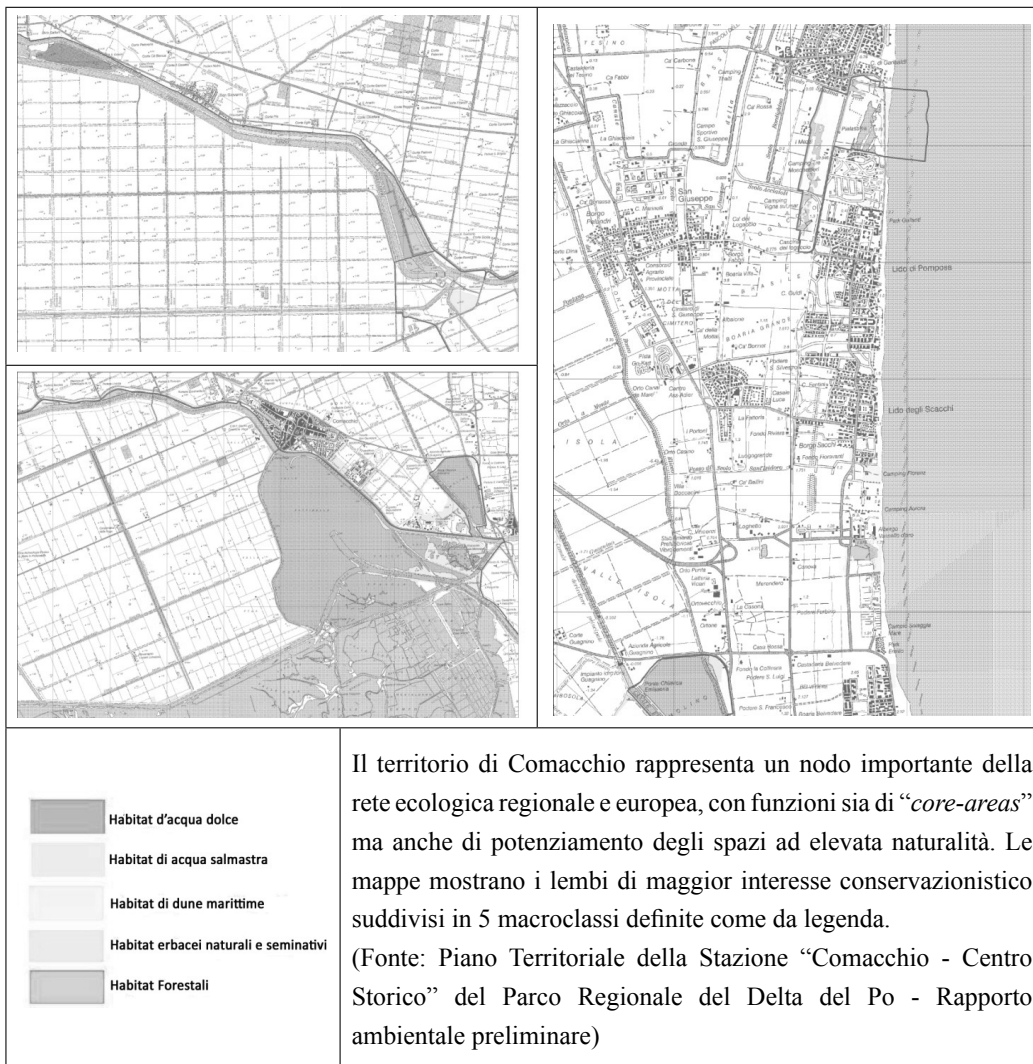
- 1) *“L'acqua come patrimonio – Esperienze e savoir faire nella riqualificazione delle città d'acqua e dei paesaggi fluviali”* (Programma U.E. *“Cultura 2000”*);
- 2) LIFE09/NAT/IT/110 *“Conservation of habitats and species in the Natura 2000 sites in the Po Delta”* (Programma U.E. *“LIFE”*);
- 3) LIFE10NATIT000256 – MC SALT *“Environmental Management and Conservation in Mediterranean salt works and coastal lagoons”* (Programma U.E. *“LIFE”*).

Questi Progetti considerano aree strategiche le zone umide costiere del Delta del Po veneto ed emiliano ed in particolare il patrimonio vallivo di Comacchio, condividendo e adottando alcuni tra i principali progetti strategici previsti nella Relazione elaborata per l'adozione del Piano Territoriale

della Stazione Centro Storico dell'Ente di Gestione per i Parchi e la Biodiversità – Delta del Po (I progetti strategici sono di seguito schematizzati per i diversi sistemi individuati dal Piano).

<p>Sistema di connessione tra Comacchio e la fascia costiera (Parco urbano)</p>	<p>Sistema delle acque interne</p>	<p>Bosco Eliceo e sistema dunale antico</p>
<p>Bosco Eliceo e sistema dunale antico</p>	<p>Centro Storico</p>	<p>Valle Isola</p>
<p>Fonte: Relazione P1 – Piano di Stazione Centro Storico di Comacchio (adozione 20/12/2012)</p>		

Il primo Progetto “*Acqua come patrimonio*” (Responsabile Scientifico Prof. Arch. Farinella di CITER/UNIFE) ha come obiettivo portante la riscoperta dell’importanza dei fiumi e dei paesaggi d’acqua in genere, all’interno delle strategie di rilancio economico, nonché di riqualificazione e valorizzazione, sia urbana che paesaggistica, del territorio costiero. Tale intento ha origine dalla considerazione dell’estrema ricchezza antropologica che tali ambiti, da sempre, hanno rivestito per la storia della civilizzazione umana, divenendo, quasi ovunque, elementi strutturanti i territori, nonché condizioni fondanti di molti degli assetti economici e sociali, delle popolazioni insediate.



L’ambito scelto per “ragionare di futuro” nei territori costieri è locale, collocato entro il territorio comunale di Comacchio, un caso studio di estremo interesse, essendo un paesaggio da sempre conformato, trasformato dai sistemi di controllo, regimentazione e sfruttamento delle acque (vedi fig. 2).

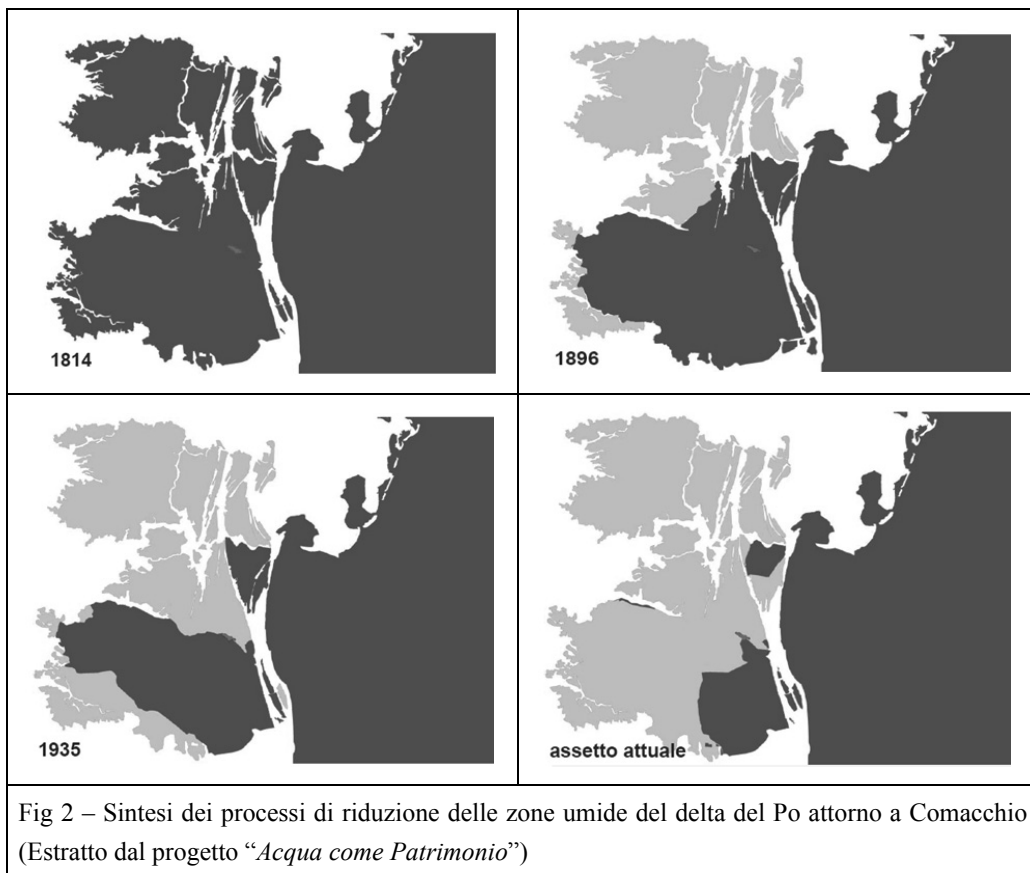


Fig 2 – Sintesi dei processi di riduzione delle zone umide del delta del Po attorno a Comacchio (Estratto dal progetto “Acqua come Patrimonio”)

Solamente a partire dal secondo dopoguerra tale stretta simbiosi fra antropizzazione e sistema delle acque è andata progressivamente riducendosi, con effetti negativi sugli attuali assetti territoriali. Il passato ha però lasciato numerose testimonianze, alcune divenute, oggi, patrimonio storico e museale, altre tuttora “*in uso*”, che consentono, se adeguatamente valorizzate, di ripercorrere la genesi e le modificazioni di tale territorio.

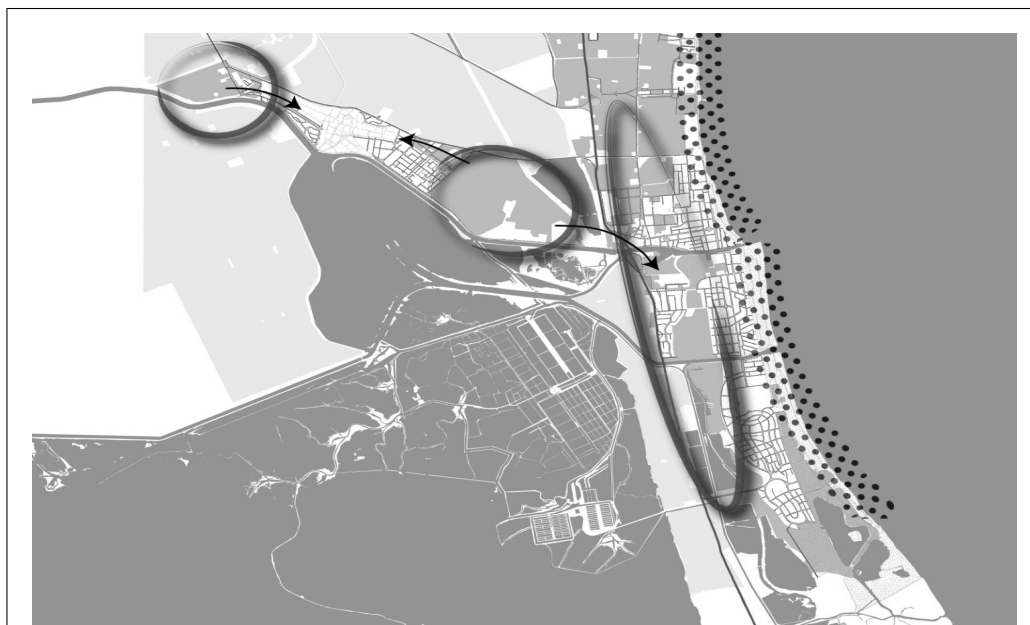
La ricchezza antropologica dell’area costituisce una potenzialità di primissima importanza in quanto l’acqua, e i valori ambientali, paesaggistici e culturali di cui si fa portavoce, costituiscono:

- Elemento strutturante per il territorio;
- Condizione fondante per economia e società locale.

Gli obiettivi del Progetto mirano a proporre un cambio sostanziale di direzione in materia di scelte pianificatorie, riscoprendo l’importanza dei fiumi e dei percorsi d’acqua nelle strategie di rilancio economico e nei processi di riqualificazione e valorizzazione urbana e paesaggistica del territorio costiero.

L'acqua, in questo senso, viene intesa quale “nuovo standard urbanistico”, dotata, cioè, di un proprio grado di obbligatorietà in ogni scelta che comporti una trasformazione del territorio.

Un'acqua in grado di declinarsi al plurale, al pari di altre dotazioni urbanistiche, assumendo, a seconda dei casi, uno o più fra seguenti status (2): spazio pubblico, infrastruttura per la mobilità, meccanismo per il controllo idrico, ambito produttivo, elemento di valore ambientale, nodo ecologico, componente del paesaggio, ecc.



Planimetrie delle aree oggetto di approfondimento del Progetto EPAT (Programma Europeo Cultura 2007 – 2013). Elaborazione e Fonte: Lab. Citer, UNIFE

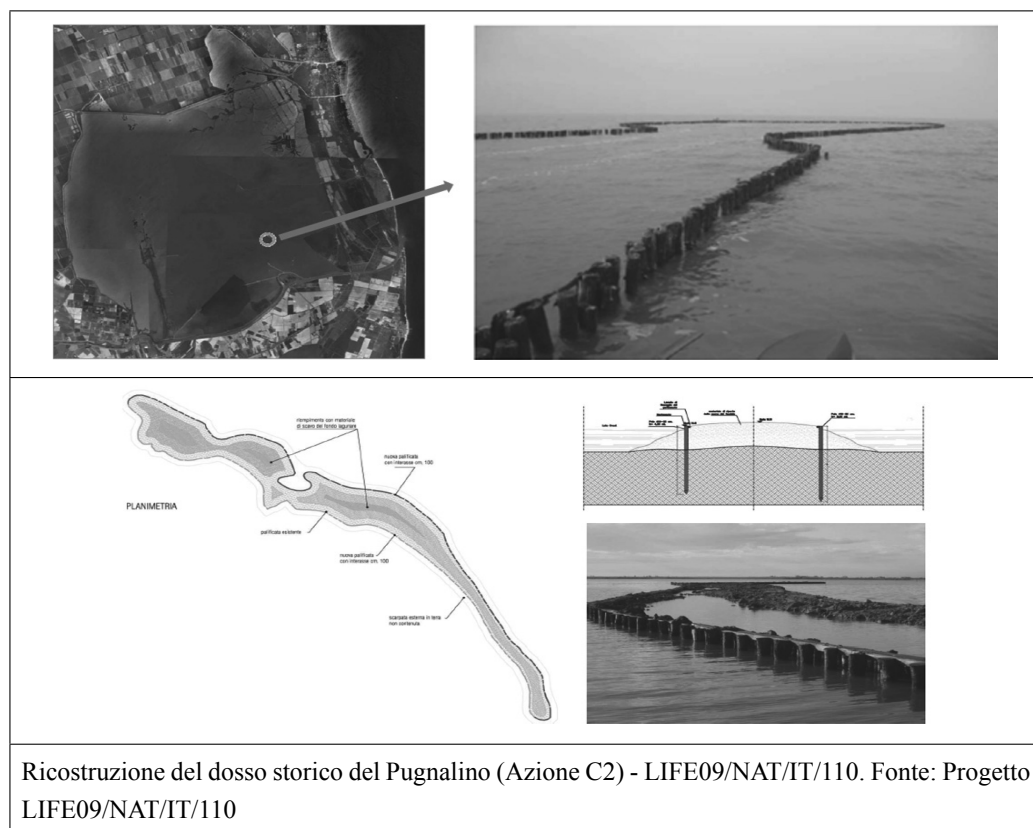
Il Progetto “*Acqua come patrimonio*” propone quindi il ritorno ad un uso sapiente del sistema delle acque quale possibile alternativa (o contributo) alle attuali pratiche urbanistiche, che hanno dimostrato la propria incapacità di poter governare, con efficacia ed efficienza, un territorio estremamente complesso e contraddittorio, quale appare il litorale comacchiese.

Oggi è necessario costruire una scala di valori per un sistema di riferimenti etici necessari all'uso ed al governo della “*risorsa acqua*” L'acqua ci può aiutare ad elaborare e sperimentare nuovi comportamenti ed esprimere nuovi valori.

Il tema acqua ha implicazioni economiche, politiche, sociali di vasta portata e nello stesso tempo attorno all'acqua si aprono sfide ricche di tensioni ad alto contenuto progettuale.

L'adozione di aree campione, in cui il concetto di sostenibilità dello sviluppo deve marciare di pari passo con l'uso delle risorse limitate, costituisce una proposta che integra tutti i settori coinvolti (urbanistica, sviluppo industriale, agricolo, di servizi, ecc.) per dare luogo ad un modello in grado di autogenerare risorse e sviluppare politiche di gestione territoriale integrate e di cui l'utilizzo delle acque costituisce parte determinante ma non esclusiva.

In questo senso, ogni intervento nei due Progetti LIFE in corso (LIFE09/NAT/IT/110 “*Conservation of habitats and species in the Natura 2000 sites in the Po Delta*” e LIFE10NATIT000256 – MC SALT “*Environmental Management and Conservation in Mediterranean salt works and coastal lagoons*”), relativi alle valli da pesca e alle saline, costituisce una proporzionata espressione di equilibrio, rifugge dal concetto così frequentemente utilizzato in passato, della banalizzazione della diversità naturale e delle attività antropiche inserite nel contesto di un neo-ecosistema.





Fonte: Progetto LIFE09/NAT/IT/110



Riscavo del tratto terminale del canale sub-lagunare Fattibello e del canale Ungola (Azione C1) - LIFE09/NAT/IT/110. Fonte: Progetto LIFE09/NAT/IT/110

Contemporaneamente alla ricostruzione e al ripristino degli ecosistemi con principi scientifici, infatti, trovano spazio le attività collegate al nuovo concetto di sviluppo (basato su cultura e turismo ad esempio). Per questo motivo il Parco si rivolge alle imprese in grado di fornire servizi tecnici, turistici e culturali, per la piena fruizione del territorio.

L'avvio di questi sistemi di conservazione della natura prelude ad una gestione integrata, in grado di fornire elementi di benessere anche per l'uomo.

Si è consci che tale modo di rivisitare la realtà comporta una ampia differenziazione nel modo di concepire la pressione antropica ed il controllo del territorio. Elementi ed esigenze antropiche, se gestite e monitorate, dalla piccola alla grande scala, possono svolgere un ruolo decisivo per lo sviluppo e il miglioramento ambientale e territoriale, in relazione ai territori-guida di straordinario valore più compromessi dalla pressione antropica e agli elementi eco sistemici.

Questo nuovo approccio metodologico può già da ora rappresentare una potenzialità per le nuove politiche di gestione e valorizzazione delle risorse ambientali, naturali e paesaggistiche.



## Ringraziamenti

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**EFFECTIVE RESTORATION OF THE ENDANGERED EUROPEAN EEL (*Anguilla anguilla*)  
IN PROTECTED AREA: A PROPOSAL FOR COASTAL ZONE.**

Abstract: The European eel (*Anguilla anguilla*) is a catadromous fish species present across the European continent and along the Mediterranean coasts. Because of an intensive decline in the major part of its distribution area, the stock is considered to be below safe biological limits. Although classified as Critically Endangered, *A. anguilla* is still a commercially important species.

Regulation n.1100/2007 (EC, 2007) imposes on the European Member States the monitoring of the local stocks and the implementation of an Eel Management Plan (EMP) on a river basin scale, for the restoration of eel population.

This work proposes the use of morphological measurement for evaluation of fish health, in association with internal indices, blood parameters and biomarker. The objective is to evaluate the condition of eels captured during the reproduction migration from internal waters to open sea. Eels were studied in growth, age, and health status. The study area is the Comacchio lagoon, a brackish coastal lagoon in Italy and results show an excellent stock with a huge potential: this stock could be used for natural restocking of whole European population. Brackish coastal lagoons can be managed in order to provide the right environmental conditions for eel breeding and protected area are dramatically important for this task.

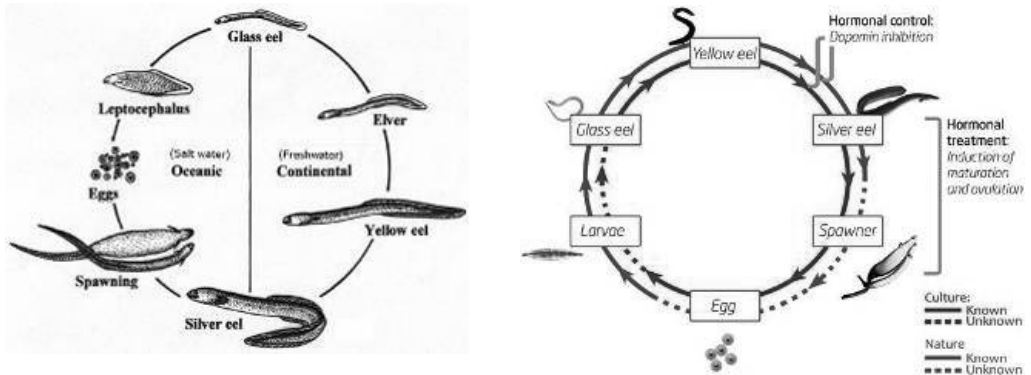
Keywords: *anguilla anguilla*, biodiversity conservation, coastal zone, eel management plan, protected area

## Introduction

The European eel (*Anguilla anguilla*) is a catadromous fish species present across the European continent and along the Mediterranean coasts (Tesch, 2003). The life-history of this fish depends strongly on oceanic conditions; maturation, migration, spawning, larval transport and recruitment dynamics are completed in the open ocean (Tesch, 2003). Its spawning grounds thousands of kilometers away in the ocean, possibly the Sargasso Sea (Knights, 1996; Feunteun, 2002; Aarestrup et al., Science 2009). Leptocephalus larvae are transported along the Gulf Stream and North-Atlantic

Drift for a journey of seven to eleven months (Lecomte-Finiger, 1992) or some years (Schmidt, 1922; Liew, 1974; Boetius and

Harding, 1985; van Utrecht and Holleboom, 1985; Feunteun, 2002). The continental distribution of the European eel includes virtually all types of waterbodies, namely rivers, lakes, reservoirs, coastal lagoons, estuaries and coastal areas (Moriarty & Dekker, 1997).



Biological cycle of European eel (left, ICES) and its knowledge in nature and culture (right, pro-eel.eu)

In the past three decades, European Eel has suffered an intensive decline in the major part of its distribution area, and the stocks are now considered to be below safe biological limits (Moriarty and Dekker, 1997; Feunteun, 2002; Dekker, 2004; ICES 2010).



Picture of European eel in natural environment (ARKive, © Tim Martin / naturepl.com).

The reasons for these declines are not well understood and different factors are likely to have contributed to such decline, including overfishing, habitat loss, presence of parasites, climate change, and poor water quality mainly related to chemical pollution (Feunteun, 2002). The impact of these factors on eel populations is exacerbated by the complex biological cycle of the fish which includes

an extremely long migration in marine waters. Adults die after spawning, while larvae will return along the coastal waters and newly metamorphosed glass eel will migrate upstream into estuarine and fresh waters. The growth phase (yellow eel) in continental waters lasts for several years (6-12 for males and 9-20 for females), and ends with a second metamorphosis called silvering (silver eel), that immediately precedes the transoceanic reproductive migration (Colombo and Grandi, 1995). The transformation from yellow to silver eels is therefore a key event preparing the future spawners for migration and reproduction. During their continental life cycle phase, eels accumulate a considerable amount of lipid reserves, which are fundamental for the success of the long oceanic migration since during this period they do not feed (Robinet and Feunteun 2002; Ribeiro et al. 2005; Palstra et al. 2006) and their digestive tract regresses (Durif et al. 2005; van Ginneken et al. 2007). At the continental level, exploitation, habitat loss, migration route obstruction, and transfer of parasites and diseases may contribute to the decline. Poor condition and lower energy reserves were reported to interfere with the migration of silver eels from the European coasts to the Sargasso Sea and hamper successful reproduction (Larsson et al., 1990; van Ginneken et al., 2007). Pollution can also have indirect adverse effects on eel populations by for example decreasing the water quality (e.g. eutrophication) or decreasing the availability of food by reducing prey populations. Eels are efficient bioaccumulators of xenobiotics as a result of their high fat content, long life cycle, and exposure to contaminated sediments. Eels do not eat during their migration (up to 6,000 km from the European sea coasts to the Sargasso Sea), and it is therefore assumed that they had previously accumulated sufficient energy reserves.

The European eel was included in Appendix II of CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora - CITES, 2008) and recognized as an “endangered species”. European eel restoration was attempted over the last decades (Moriarty and Dekker, 1997) but the decline continues. The European Union with Regulation n.1100/2007 imposed monitoring and restocking of this species as defined in an Eel Management Plan (EMP; EC, 2007) for each river basin. The Regulation states that the 40% of the silver eel biomass escaping from inland waters must reach the sea in order to increase the possibility to restore naturally European eel populations. However, no tools for the evaluation of escaping fish were provided within the EMP, where the quality of breeders, among other parameters, may represent a valuable target within a restoration program. As discussed by Geeraerts and Belpaire (2010), the EU eel recovery plan (EC, 2007) should include evaluation of silver eels as well as a comprehensive overview of the quality of the silver eel population all over Europe seems to be an essential and urgent objective for the European eel management.

## Materials and methods

The Sustainable EEL Fishery (SEELF) Index was designed for the evaluation of conditions of migrating fish. Two versions are proposed:

“SEELF A” to be used in the field for rapid evaluation of fish condition, without sacrificing the animals. Calculated on randomly sampled eels.

“SEELF B” to be used for research and quality control purposes. Calculated on mature eels.

SEELF A consists of four objective parameters including (1) ASR or the Adequate Sampling Ratio (total body Length / (total body Weight \*0,785)); (2) Silver Index (according to Durif et al. 2009); (3) Eye Index (according to Pankhurst, 1982); and, (4) Condition Factor (according to Fulton, 1904). SEELF A is based only on external measurements and it is therefore suitable to be used in the field.

SEELF B consists of the four indices noted for SEELF A and four additional parameters, including an internal index (hepato-somatic Index, HSI), two haematological parameters (RBC and HT) and a subjective evaluation of skin (SE, skin evaluation). For SEELF B determination, fish are sacrificed by decapitation, blood samples taken for haematocrit (HT) and red blood cell counts (RBC), and the liver weighed for calculation of HSI. Skin evaluation (SE) is performed without any manipulation or damage to the carcass. Parameters are evaluated on the basis of a threshold or a range (see 3.3.2). To assign a numerical value to variables, each parameter that represents a normal condition is replaced by a one; otherwise by a zero. As only exception, SE is classified on a scale of 0 to 1 (0=severe damage, 0.5=moderate damage, 1=no damage).

The sum of all values is normalized to 10 and assigned as value of SEELF. This ranking system assures that every sample is evaluated from 0 (min) to 10 (max); therefore the SEELF index is always a number in the range 0÷10.

The SEELF Index aims to quickly evaluate a fish, both for fishery management (catch&release, capture for food processing,...) and biodiversity conservation (health evaluation, release to open water,...). SEELF provides an easy and raw methodology, usable by fishermen, conservationists, researchers and protected area managers. When the target is the evaluation of a trend, the ranking system permits the comparison of fish sampled in different times (e.g. the set of parameters can change) or in different habitat (e.g. the parameter's threshold/range can change). Thus, SEELF is a tool for evaluation and comparison, useful in stock management.

The following table summarizes the parameters included in the SEELF Index

N	Parameter	SEELF A	SEELF B
1	Adequate Sampling Ratio	✓	✓
2	Condition Factor	✓	✓
3	Eye Index	✓	✓
4	Silver Index	✓	✓
5	Hepato-somatic Index	✗	✓
6	Hematocrit	✗	✓
7	Red blood cell count	✗	✓
8	Skin Evaluation	✗	✓

List of parameters included in the two version of the SEELF Index.

SEELF index is calculated as:

$$\frac{\sum_{i=1}^N P_i}{N} * 10$$

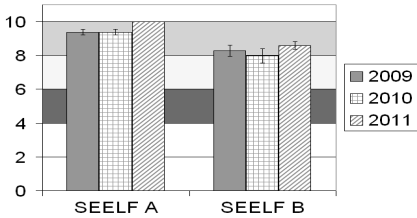
where  $P_i$  is the value of the  $i$ -th parameters and  $N=4$  (SEELF A) or  $8$  (SEELF B).

## Results and Discussion

The evaluation of SEELF (both A and B version) can be performed in classes, top (from 8 to 10, green in fig. 5.3.1), middle (from 6 to 8, yellow in fig. 5.3.1) and low (from 4 to 6, red in fig. 5.3.1). Another class, from 0 to 4 (white background), can be defined as unacceptable.

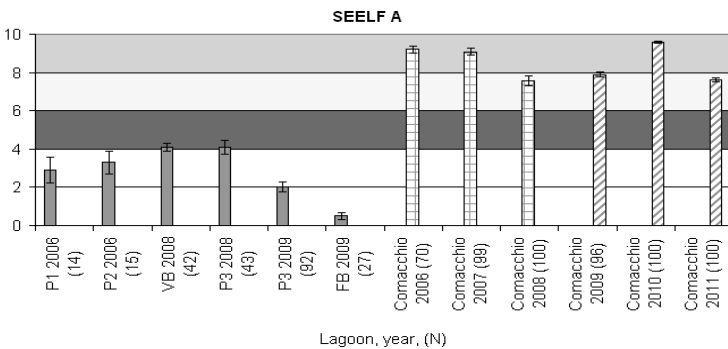
SEELF A provides a quick evaluation of fish condition and can be used in field, while SEELF B is a useful tool for a more detailed evaluation of fish condition, suitable for research and quality control for food productions. The low SEELF A values recorded in 2008 and 2009 are probably due to inappropriate fishery management, i.e. the use of fyke-nets instead of an exclusive use of the lavoriero (Po Delta Park, personal communication).

SEELF B showed lower values with respect to SEELF A, indeed, SEELF B provides a more accurate evaluation of fish condition, therefore such a difference was easily predictable. The 2011 provide the highest scores for both indices, with SEELF B of the 2010 is near to the middle class and thus, it provides an early warning on fish quality.



Comparison between SEELF A and SEELF B in mature eels, with quality classes displayed.

SEELF seems to provide an adequate description of samples, defining a methodology for fish evaluation. Although modification are possible, the SEELF approach aims to evaluate eel stock and to give a trend in mid-long term. The Comacchio lagoon is historically recognized as an important habitat for eels, while other coastal lagoons, surrounding Comacchio or in other Adriatic coast zone, give different result. The following figure show the SEELF A calculation on Group A and other historical data.



Graphs of SEELF A calculated on eels harvested in Comacchio lagoon from 2006 to 2008 and other coastal lagoons (from 2006 to 2009), with quality classes displayed. Data are reported as mean±SE.

As reported, other coastal lagoons provide stock with less interesting features, because of a low value of SEELF A, classified in unacceptable class. Although evaluated in few samples (from 14 to 92), these lagoons are very far from the performance measured in the Comacchio lagoon. The variability in Group A (sampling for calculation of SEELF A) score is explainable by the use of fyke-nets during the eels captures, as confirmed by the Po Delta Park (personal communications). During one or more harvest, the personnel did use the fyke-nets and this was easily evaluated during the morphometric estimates. However, there is no an official registration of period of capture-tools of capture, and this discussion is still an hypothesis, even if informally confirmed. A similar reason is addressed to P3 scores in 2008 (4.1) and 2009 (2), but no official details on capture tools are available.



Both differences in Comacchio and P3 lagoons show that management capability are dramatically important for sustainable eel fishery.

## Conclusions

The SEELF index aims to provide a methodology for measurement of eel conditions, according to use of fish: aquaculture and other commercial uses (SEELF A) and quality control and research (SEELF B). Both indices were designed as a practical solution for a very complex problem, as well as the evaluation of a specie during a metamorphosis is a huge scientific task. Although some limitations in the use of indices, the Eel Management Plan needs of some tools for fish evaluation, for analysis of trends, both in the same habitat and between different environments. In general, the designation of restocking area and other area where to spend public funds for restoration of habitats for eels, should include a methodology as the one proposed by SEELF.

In order to boost the restocking of European eel at continental scale, the following items are proposed:

### A. Designation of European Restocking Areas (ERAs)

The ERA is defined as a closed basin, where restocking can be performed effectively, regarding the following requirements:

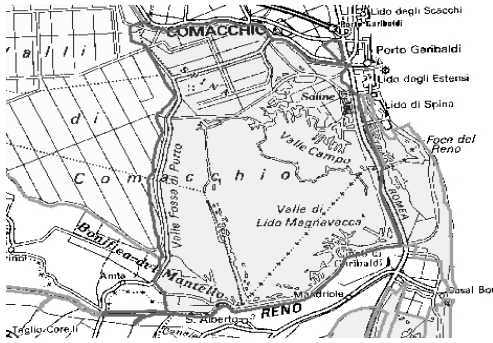
- ✓ habitat with a good ecological state
- ✓ young age at maturation of eels
- ✓ absence of parasites
- ✓ capability to adapt environment and human practices for a sustainable eel fishery

### B. Planning an European Scale EMP

As a concrete proposal, the European restocking effort should be performed only in designed ERAs, assuring reduced mortality, age at maturity <10y and good health conditions (measurable with SEELF index or other indices) of migrating eels. An effective EMP should consider measures for reduction of eel mortality all over the continent, and should identify ERAs where to use public funds for in eel restoration. Based on the European scale of the problem (eel decline), the European scale EMP (EsEMP) aims to unify the European Countries in funding eel restocking.

Clearly, the EsEMP could be performed only with a large agreement between the Member States and performed by public-private partnership with the most skilled privates.

Finally, an effective Eel Management Plan supports both eel fishery and eel conservation, and Mediterranean coastal lagoons are suitable environments. With regards to Italy, the proposed European Restocking Areas lie in North Adriati



The Natura 2000 site IT4060002: Comacchio lagoon.

In this habitat, each conservation action can be planned and performed in order to reduce the time for restoration of stock. In the Comacchio lagoon nowadays a public-private partnership can realize the dream to restore the eel population at the historical level of a Century ago.

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## **THE UNMANNED SURFACE VEHICLES TO STUDY SHALLOW-WATER COASTAL AREAS**

Abstract: Due to their natural and economic importance, coastal lagoons and more in general “wetlands” (as defined in the Ramsar 1971 convention) require periodical environmental monitoring because they are prone to ecological crises often related to anthropogenic impact. According to their complexity, the study of these ecosystems involves a combination of investigative approaches, such as biology, physical and chemical oceanography, and geology. On the other hand, the main characteristic of these environments is the extremely shallow bathymetry and the variability of bottom types, controlled by geological/biological factors, such as mean grain-size of the sediments, erosional or diagenetic levels, presence of bioconstructional features, etc.. For these reasons, they are difficult to study and monitoring. It comes out that techniques that could allow periodical environmental monitoring of these area are required, that could fit needing of: 1) low cost; 2) low environmental impact; reliability and reproducibility of the measures. All these task could be accomplished using a new tool in marine coastal studies, the *Unmanned Surface Vehicle (USV)* that could carry out autonomously geological-geophysical-geochemical surveys of underwater ultra-shallow areas.

This new technology is under development in several scientific institutions, such as the *Tecnopolo dell Emilia Romagna*, in Italy. In this frame, a new type of USV, the Shallow Water Prospector (SWAP) have been developed (Figure 1). First tests indicate that the study of these areas through this approach has the potential of collecting densely-spaced grids of data at a low cost, allowing for execution of repeated surveys that could give important insights in understanding geo-environmental processes in these rapidly evolving environments.

### Introduction

Coastal areas are particularly affected by anthropic pressures (harbours, tourism, industrial plants, etc.) because densely populated. For this reason, they would require periodical monitoring to evaluate whether they are in a state of “equilibrium” from the geo-biological point of view. In fact, it is not uncommon that unbalances in environmental variables, either caused by human activity or natural process, could cause dramatic crises, such as algal blooms, coastal erosion and water pollution.

Geo-environmental studies are not a common practice in coastal zones management, and the required multidisciplinary knowledge can be offered only by public research institutions. Furthermore the high costs of sophisticated technology is out of range for the budget of local environmental protection agencies or for private consulting enterprises, that work eventually for public agencies (regional offices, government agencies, port authorities), as well as for other private subjects (industrial plants, resorts, etc.). This call for new technologies and scientific methods that could open these practices to a wider spectrum of users, on one side simplifying and better standardizing the survey procedures; on the other side, reducing the costs.

We are developing new methods and technologies for the geo-environmental analysis of geological hazards in coastal areas that could extend geo-environmental studies to a wider community. Objectives should include the transfer of technology to suppliers of goods or services, to enable an expansion of market horizons. Research activity develops along two related lines (1) realization and development of low-cost Unmanned Surface Vehicles (USV); (2) definition of an integrated analytical method for the assessment of geo-environmental risk.

For the purposes of our research, the term USV refers to an unmanned vehicle that operates on the surface of the water for geophysical, geological and geochemical surveys of both submersed coastal areas (up to 100 m depth) and of areas that require periodical monitoring of physical-chemical parameters (bathymetry, solid transport, pollutants resuspension) in order to define appropriate prevention, intervention or reclamation strategies (harbours and industrial areas).

The proposed USV (Figure 1), named SWAP (Shallow-WATER Prospector), is a highly flexible instrument and can be easily adapted to various monitoring conditions or prescriptions, and thus used for general purpose as well. It can be equipped with geophysical sensors such as vertical and lateral echo sounders, magnetometers, sub-bottom profilers, as well as chemical-physical sensors and current meters for a comprehensive characterization of the water column.

Parallel to the development of the vehicle we are defining new methods to carry out integrated geological-ecological studies of coastal areas. Depending on the specificity of the investigated area, data shall be integrated with the definition of sampling protocols, and the study of sedimentary successions in order to establish: i) a record of natural events (landslides, earthquakes, and tidal waves; ii) the chronology of major events; (iii) the interrelations among these and active geological processes in the various investigated areas.

These lines of activity will allow to define a data acquisition protocol for the whole spectrum of environmental problems associated with a specific area. They will also provide a means for accurate

monitoring strategies, prevention/mitigation of natural risks, or remediation of polluted areas. They will eventually be available to DSS (Decision Support System).

Additional examples of complex problems, are coastal areas affected by the presence of unexploded bombs or potentially pollutant shipwrecks. In all these cases preliminary investigations may be effectively and safely carried out by the USV vehicle within the frame of this project.



Figure 1. SWAP vehicle in navigation

#### SWAP technical characteristics

The vehicle is based on a trimaran framework, i.e., a multihulled boat consisting of a main hull and two smaller outrigger hulls, attached to the main hull with lateral struts. The main hulls hosts the batteries, that supply two brushless, 12V 30 W engines, controlled by a hybrid speed controller that is water-cooled. In its present configuration the vehicle is equipped with a multitasking computer under ubuntu operating system, that serves as controller for the engines, positioning and data-logger. The maximum speed reached by SWAP is 3.5 knots during a test session carried out in a small lake.

Although in its final version the vehicle will be completely autonomous, the present stage of development require the use of a radio remote controller. Quality check of the data is obtained via sub-sampling of the collected time-series, which are packed and transmitted to a host computer onshore through radio transmission.

#### Basic Sensors

Although the architecture of the system is modular and could be easily expanded to other USB-based digital sensors, 3 devices have been installed on this prototype: 1) a DGPS receiver; 2) a high-resolution single beam echosounder; and 3) a chirp-sonar subbottom profiler. These are

considered the “basic sensors” that will be likely employed in most of the survey carried out in coastal areas.

## Positioning

The vehicle is equipped with a differential GPS system that provide and accuracy of  $< 1$  m in the x-y positioning. NMEA-183 format strings are transmitted to the host computer onshore to monitor continuously the position of the vehicle and errors in the execution of the mission-related profiles. A magnetic compass and an attitude sensor (pitch and roll) will complete in the near future the navigation package.

## Sonic and ultrasonic sensors

A vertical incidence echosounder, the PSA900 manufactured by Datasonics, has been mounted onboard of SWAP. The PSA900 is particularly suitable for shallow-water environments because is characterized by a high operating frequency (200 kHz), a narrow ( $8^\circ$ , conical) beam width, a short pulse length (350  $\mu$ s), and a minimum depth range of 0.75 m. However, since our target is mostly shallow and ultra-shallow water, we modified the echosounder shortening the pulse to 200  $\mu$ s and the bottom detection/depth-estimate section was disabled, obtaining, de facto, a 200 kHz externally triggered ultrasonic pinger (see Gasperini, 2005 for further details). In this way, the shallow-depth limit was reduced to 0.2 m. In order to carry out estimates on the seafloor reflectivity, the 200 kHz echosounder signal is sampled digitally in the water column, bottom and subbottom, with a constant time window, and the data (the echograms) are stored in SEG-Y format files. For this purpose, a portable acquisition system based on a digital oscilloscope (*PicoScope*) has been designed. Echosounder triggering, quality control and storage of the acquired echograms, as well as the link with the positioning sensor, were obtained through a specific software (Figure 2) running on the main computer.

## Subbottom Profiler

A traditional chirp-sonar subbottom profiling (SBP) system operating with piezoelectric transducers is not suitable for installation on board of SWAP, either for the heavy weight of the transducers and for the power consumption. For this reason, we developed an innovative SBP system

based on magnetic loudspeakers that show interesting performances in the shallow-water environment, and is easily installed on our vehicle. The system is composed by a 1) a digital generator of frequency modulated signal controlled by the main computer; 2) a 60W RMS power amplifier, 12V power supply; 3) a water-proof 60W loudspeaker. The receiver chain is formed by a single hydrophone and an analog preamplifier that supply the signal to an acquisition software running on the main SWAP computer. Figure 3 display an example of seismic reflection profile collected in the Lake Trasimeno in 2 m of water depth. Data collected will be processed and interpreted using the open-source package SeisPrho (Gasparini and Stanghellini, 2009).

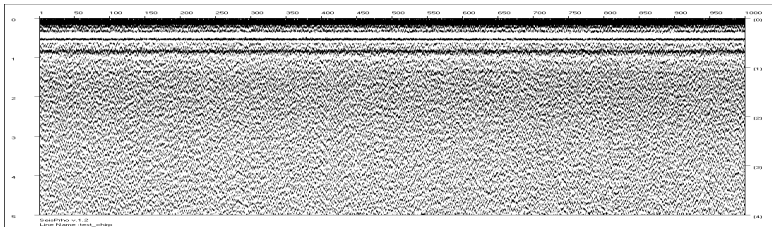


Figure 2. Example of chirp-sonar SBP profile collected in 0.5 m water depth using the portable system mounted onboard of SWAP.

### Multidisciplinary surveys

The geophysical payload presently installed onboard of SWAP is not exhaustive of all possible geological and environmental studies that could be eventually carried out in coastal areas. In fact, a multibeam echosounder or a side-scan sonar system could represent a dramatic improvement in the quality of the morphobathymetric data collection. Moreover, the peculiar design of the hull is suitable for installing an ADCP current-meters that find a wide range of application in physical oceanographic studies.

We are also planning to insert some basic chemical sensors, such as oxygen, nitrates, PH, etc.. to allow rapid assessment of the surface water quality.

A small winch will be also installed to water-column measurements.

### Conclusion

Techniques and instruments that could allow periodical environmental monitoring of shallow-water coastal areas could be interesting tools to study this important areas. These instruments should fit



the following requirements: 1) low cost; 2) low environmental impact; reliability and reproducibility of the measures.

We presented the prototype of an Unmanned Surface Vehicle that could be used for the study of coastal areas. The main characteristics of the system are the small size, that enable its use in remote areas, and the low cost, because designed using standard wide-spectrum technology.

The possibility of carrying out geophysical-geochemical surveys of coastal areas quickly, and at a fraction of the cost of conventional surveys, opens the use of this techniques to a wide range of users. Moreover, it allows to plan repeated surveys that could give a time-variant perspective to the study of natural process in these rapidly evolving environments.

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## **THE NORTHERN ADRIATIC SEA: A LONG-TERM ECOLOGICAL RESEARCH (LTER) SITE**

### Introduction

Long-Term Ecological Research (LTER), which focuses on multidecadal observations, provides the correct approach and temporal context needed to avoid serious misjudgements in our attempts to understand and predict changes in the world around us and to manage our environment. The LTER approach is particularly important when trend detection is a central issue as in global change, since many ecological processes operate at a temporal scale broader than is typically considered by traditional ecological research. LTER is also critical for testing ecological theories on community dynamics, variability and resilience, enhancing our capacity of forecasting and of managing resources.

The Italian LTER network (LTER-Italy) is included in the international (ILTER) and European (LTER-Europe) long-term ecological networks. The process that brought to the present configuration of LTER-Italy lasted 10 years and it was supported by researchers, institutions and scientific societies involved in ecological research. At present, twenty-two sites constitute LTER-Italy, representing the main ecosystem typologies on the Italian territory and they embrace terrestrial, freshwater and marine ecosystems. The inclusion of marine sites in the Italian network represents an almost unique effort in the LTER-Europe network.

Coastal marine ecosystems are among the most ecologically and socio-economically vital sites in the planet. They are intrinsically highly variable, as a consequence of their connectivity to both land and open sea. The availability of a wide array of ecological parameters and the joint efforts of different researchers and institutions, entitled the Northern Adriatic Sea (NAS) to enter national LTER network as a fundamental site for marine studies on long-term series. The Northern Adriatic Sea is the northernmost basin of the Mediterranean Sea. It is characterized by a shallow depth and by a dominant cyclonic circulation. The oceanographic and meteorological parameters show a marked seasonal and interannual variability. The remarkable river inputs (along the Italian

coast), the istro-dalmatian current (bringing high salinity and oligotrophic waters from the southern basin), and the notable sea-level range (relatively to the Mediterranean area), represent major forcings of the system. Of ecological relevance are also the urban and industrial inputs and the hydrodynamic exchange between the Northern Adriatic Sea and the lagoons, located along the Italian coast.

The NAS site results from the integration of different research stations, where ecological research and monitoring has been traditionally carried out since at least one decade, in the frame of different short-term national and international projects. Different institutions (CNR ISMAR, OGS, University Politecnica delle Marche) are cooperating in the management of the different stations and in the gathering and sharing of data in this site. At all the stations of the NAS automatic acquiring devices ensure a continuous gathering the main meteorological and hydrological parameters. The main common focus of the long-term activities in the NAS site is on the biogeochemical cycles and on the relations between plankton communities and climatology.

Within this context, in this paper we synthetically review the main achievements coming from the LTER site Northern Adriatic Sea.

#### Activities

Five different stations are located in the NAS (Fig. 1) with different focus activities.

The first one, in the Gulf of Trieste with the Paloma station, has its major focus on the study of “ocean acidification” in this area. This process leads to chemical changes of seawater composition that are of major concern for their potential effect on marine life at both species and ecosystem levels (Gattuso J-P and Hansson L., 2011). The pH variability and the inorganic carbon fluxes in the Mediterranean sea have received a little attention until last years. Only recently, some studies reported that carbon of anthropogenic origin occurs through the water column over the entire basin (Touratier and Goyet, 2009; Rivaro et al., 2010) and that about 90% has been taken up directly from the atmosphere via gas exchange (Schneider et al., 2010). Touratier and Goyet (2011) claim that Mediterranean waters have already been acidified with a pH decrease of 0.05 – 0.14 pH units, that is even higher than the average oceanic decrease and there is a growing evidence that the areas of dense water formation, such as the Gulf of Lion, the Aegean Sea and the Adriatic Sea play an important role in the acidification process of this basin (Krasakopoulou et al., 2011). Luchetta et al. (2010) compared a recent with an historical dataset and put in evidence a pH decrease of -0.063 pH units between 1983 and 2008 in two comparable North Adriatic Dense Water (NAdDW) masses, strengthening the susceptibility of this area to ocean acidification process.

The time series of inorganic carbon chemistry and biogeochemical parameters at PALOMA station, in the centre of the Gulf of Trieste, started in January 2008 to fill this gap in knowledge and to monitor ocean acidification process. An analysis of the data collected during the first two years of activity provided a basic characterization of inorganic carbon parameters and allowed to identify the main processes controlling the variability of pH and air-sea CO<sub>2</sub> fluxes (Cantoni et al., 2012).

The second station, always in the Gulf of Trieste, is called C1 and is managed by OGS. In this site the first “organized” and regular biological observations started to the early 1970s when the study of the net-zooplankton community of the Gulf of Trieste was initiated. The research activities on the Gulf of Trieste LTER site range from marine biogeochemistry to physiology, from ecology to traditional marine biology and are aimed to understanding the dynamics governing marine ecosystems in its complexity and to evaluating the role of the oceans in the global energy balance. The studies on local scale regard coastal and transition waters and address problems related to their sustainable management.

A recent review (Giani et al. 2012 in press) on the status of the marine ecosystem in the Gulf of Trieste reports the first results of the analyses of long term variability in the planktonic compartment. The variability in terms of abundance, community composition and phenology has been observed in 1986-2010 time series (Monti et al. 2012; Cabrini et al. 2012). The fig. 2 shows, for the example, the long term variability of phytoplankton abundance.

A regular monthly sampling for hydrological, chemical as well as biological (phytoplankton and zooplankton in several size classes) analysis only began in 1986. Part of the data acquired since 1986 are stored in a data bank. Since 1998 all data are stored in a data bank.

The third station, in the Gulf of Venice, is “Acqua Alta” oceanographic tower, this infrastructure, rather unique at national and international level allows long-term measurements and scientific experiments in a protected structure in off-shore environment. Thanks to the high safety and stability level of the tower a broadband connection has been installed to link instruments to the labs on the mainland giving access to real-time data that are published on the dedicated website <http://www.ismar.cnr.it/infrastrutture/piattaforma-acqua-alta/>. Along with these measurements CNR ISMAR performs monthly hydrological discrete samplings with nutrient concentrations, particulate matter, Phyto and zooplankton abundance and diversity.

The fourth and fifth station are S1 and E1, located near the Po river delta, The areas in front of the Po river delta and the Romagna coast are affected by wide eutrophication and mucilaginous phenomena by decades so they are considered favourable environments for the development of ipo-anoxic events. For these reason two fixed buoys has been installed to monitor and study these phenomena.

In the April 2004, a meteo-oceanographic buoy was installed in the S1 site (<http://s1.bo.ismar.cnr.it>), located SE of the delta of the Po di Goro, in the influence area of the main stream of the Po river: this area has been intensively studied over the years, both in the sediment and in the water column, and is considered a key area for the study of interactions between the river Po and the Adriatic basin. In August 2006 a second buoy, E1, was installed in the northern part of the Rimini coast. It has been dedicated to studies on ipo-anoxic processes, to the implementation and validation of oceanographic forecasting models and to the implementation of a Decision Supporting System (<http://e1.bo.ismar.cnr.it>).

The sixth study area is located near Ancona, at the end of the NAS basin and is sampled on a transect that ideally close the basin. Monthly samplings are performed in order to obtain a budget of geostrophic flows of biogeochemical parameters entering and leaving the basin. The ISMAR-CNR of Ancona, in collaboration with University of Padua and with the Polytechnical University of Marche collects from the end of years 80s physical, chemical and biological data of a transect located in the northern Adriatic: Transect of Senigallia. This is an excellent observing site to analyze the characteristics of water masses entering and leaving the North Adriatic Sea and their possible modifications. Hydrological and nutrient concentration were collected intermittently from 1988 to 1998, monthly from 1999 to 2002 and bimonthly thereafter until today. Data on phytoplankton communities (abundance, biomass and community structure) collected with a monthly frequency are available from 1988 to 2002 and from 2007 to present.

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Figure Caption

Figure 1. –Stations of the Northern Adriatic LTER site and institutions responsible of each station: 1) Gulf of Trieste, OGS Trieste-ISMAR Trieste; 2) Gulf of Venice ISMAR Venezia; 3) Po river Delta S1 ISMAR Bologna; 4) Senigaglia-Susak transect, ISMAR Ancona.

Figure 2. Box plot representing annual phytoplankton abundance with regime shift (dots) from Cabrini et al. 2012.

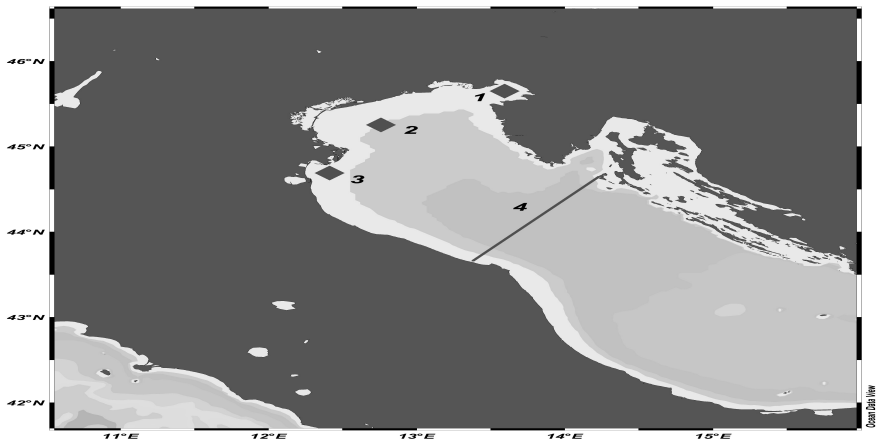
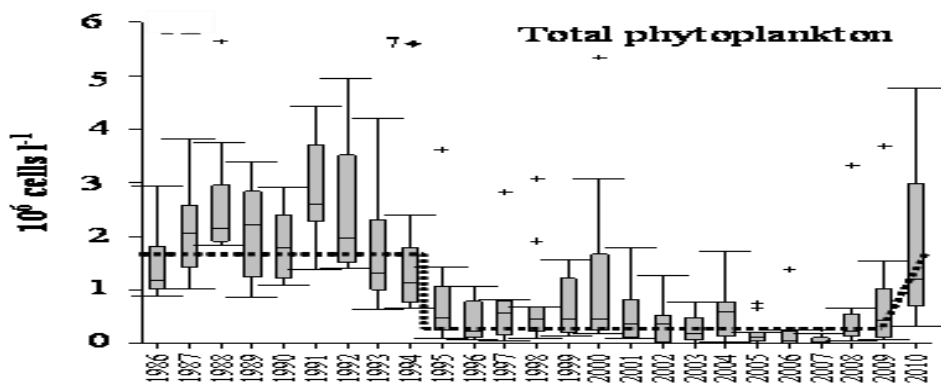


Fig. 1.



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## **THE ADRIATIC COASTAL ZONE GEOMORPHOLOGY**

### Introduction

Since the beginning of this century, everywhere in the world, the coastal areas have, been affected by a widespread regression, which reached the critical stage after 1950. This situation is in contrast with the general trend of accretion that has affected the coastal zone in the past century.

The 8000 kms of Italian coast show a large variety of shoreline. Today about forty- five percent of the Italian coast is threatened by a progressive and general degradation which mainly is manifested as beach erosion. This phenomenon seemed to worsen in the '50s after a long period of general beach stability (fig. 1).

If one considers the intense interventions of man on its coasts for touristic purposes, by demolishing the dunes to create beach areas, summer residential and marine areas; the diminished fluvial sediment load to the sea by haphazard removal of riverbed material; the creased subsidence caused by groundwater, gas and oil extractions in areas too dose to the sea; one obtains a picture which easily explains the rapid instability of this coastal environment. This situation is present not only along the Italian coast but, in a greater or lesser degree, includes the coastlines of many other countries.

This increased economic development, without worrying about what would be the future impact on the environment, tends to worsen the already precarious situation even more.

From the end of the fifties, up to the present day, the coastal area -was used as an inexhaustible and indestructible property on which it would be possible to burden an infinite "number of works without this feeling the least bit. An improper exploitation (by 'robbery') was used in this fragile region, without taking into account the consequences, instead of managing it as a precious commodity which must last in time to permit better economic management.



## The Adriatic coastal zone

The upper Adriatic coast of Italy, from the Venice Lagoon to South (fig. 2), is a good example of the above mentioned state of environment destabilisation.

Going from North to South, one first meets the thin Venetian littoral, with the lagoon at its back; the Po River Delta follows, continuously developing into the sea. From here to the Gabicce promontory a continuous shallow littoral, with the Po plain at its back, extends. From the Gabicce promontory to the promontory of Ancona and from here to South the coast is a narrow, sandy and gravelly strip which in some places lies at the foot of a cliff belonging to the Apennine Mountains, very often close to the sea.

The only factor common to such a morphologically diverse coast is erosion. To make up for the increasing erosive processes, many kinds of defense works have been put into operation. The sea walls («Murazzi») associated with groins to protect the Venice lagoon; dikes to defend the lowland behind the shoreline and longard tubes in the Po River Delta; breakwaters from the Po Delta to Punta Penna promontory lie here and there along coastal stretches mainly protected by groins, or star-shaped concrete elements established on piles or by underwater barriers, constructed of synthetic sacks filled with sand and laid down in a cell-like system where cell is artificially replenished with sand.

All these protective works, constructed at different times and impelled by necessity, involve the coast without guaranteeing its future stability. Moreover, since they were built in the course of erosive process, their cost was astronomical.

If one considers the evolutionary trend of the whole coastal area from Venice to Punta Penna promontory, it is possible to show some significant parameters derived from the numerous preceding studies.

Along the Venetian littoral, both an apparent stability of the shoreline and anomalous accretions near the jetties have been occurred. The former situation is due to the «Murazzi» that, from ancient times, have protected the beach stopping any shoreline change, but did not prevent the sea bottom slope from increasing. An increase in bottom slope is also noted in the Po delta area from the 1960s on, in connection with the diminished fluvial sediment yield to the sea which allowed the submersion of the more external sandy barriers of the deltaic system.

From the comparison among variations of bottom slope from the shoreline' to the 5m isobath, for different time periods, one can see that erosion gradually developed in time through a continual increase in the near shore bottom slope which in turn led to a shoreline regression, often achieving irreversible situations.

In particular, if the bottom slope from shoreline to 5m isobath is  $<0,50\%$ , the littoral is stable, the interval  $0,50-0,75\%$  shows an unstable situation, the interval  $0,75-1\%$  means a danger situation for the shoreline stability and with a bottom slope  $>1\%$  we are sure that the storms waves attack the backshore with regression of the shoreline. These parameters have validity, of course, only for the considered coastal area. In particular, along the Adriatic coastal zone, the validity of this parameters is only for the littoral from the Po river delta up to the Gabicce promontory with the Po plain at its back.

This fact clearly demonstrated how it would be possible to predict beforehand the final step of the general degrading of the coastal strip (present situation).

## Conclusions

It is quite evident, from the studies made, the possibility of a preventive action to avoid erosive phenomena, which, to day, are very dangerous and very difficult to solve. Not only in Italy, but even in many countries coastal protective structures are, built only after the setting in motion of the erosive process, and in many cases when it is irreversible.

A tardy intervention is, of course, more expensive and more difficult.

To conclude, we remember that if the strong man activity on the coastal zone at the present time is the undeniable cause producing danger interference in the coastal environment, we must also consider the frequency of storms waves that always set off the destabilization of the coastline already compromised by the man activity. In order to better understand the processes that control the coastal evolution it is necessary to quantify the influence of the climatic variations and the possible interaction with the man activity on the landscape.

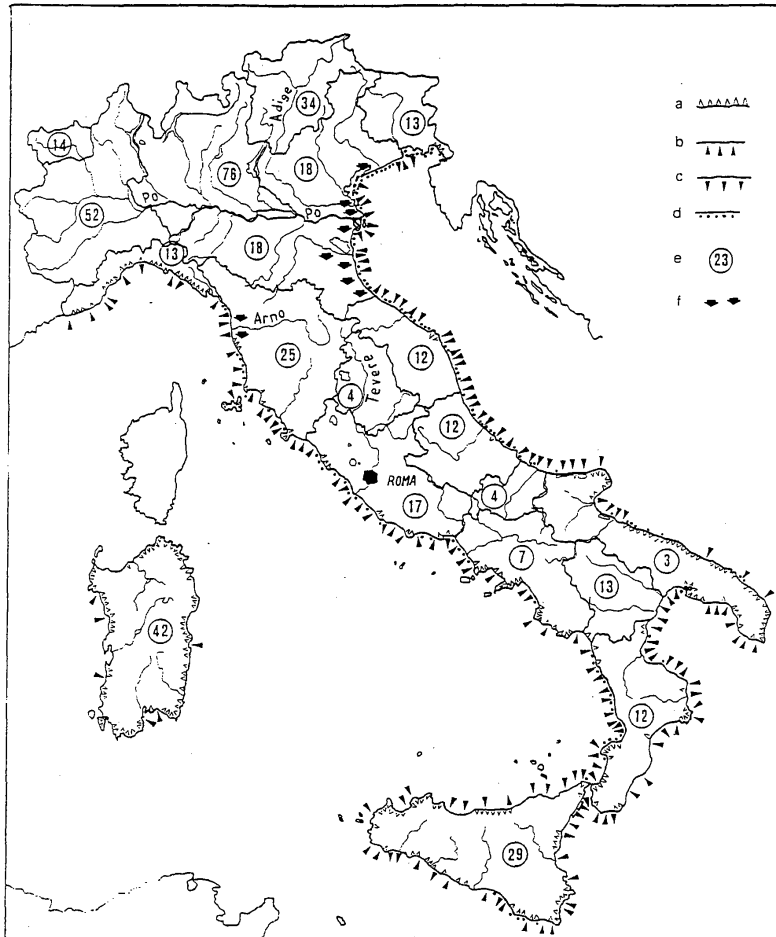


Fig. 1 The Italian coast: a) Rocky coast; b) shoreline regression; c) shoreline advancing; d) defense works; e) total number of the artificial basins along the rivers in the different regions; f) presence of subsidence (Mastronussi, 1995).

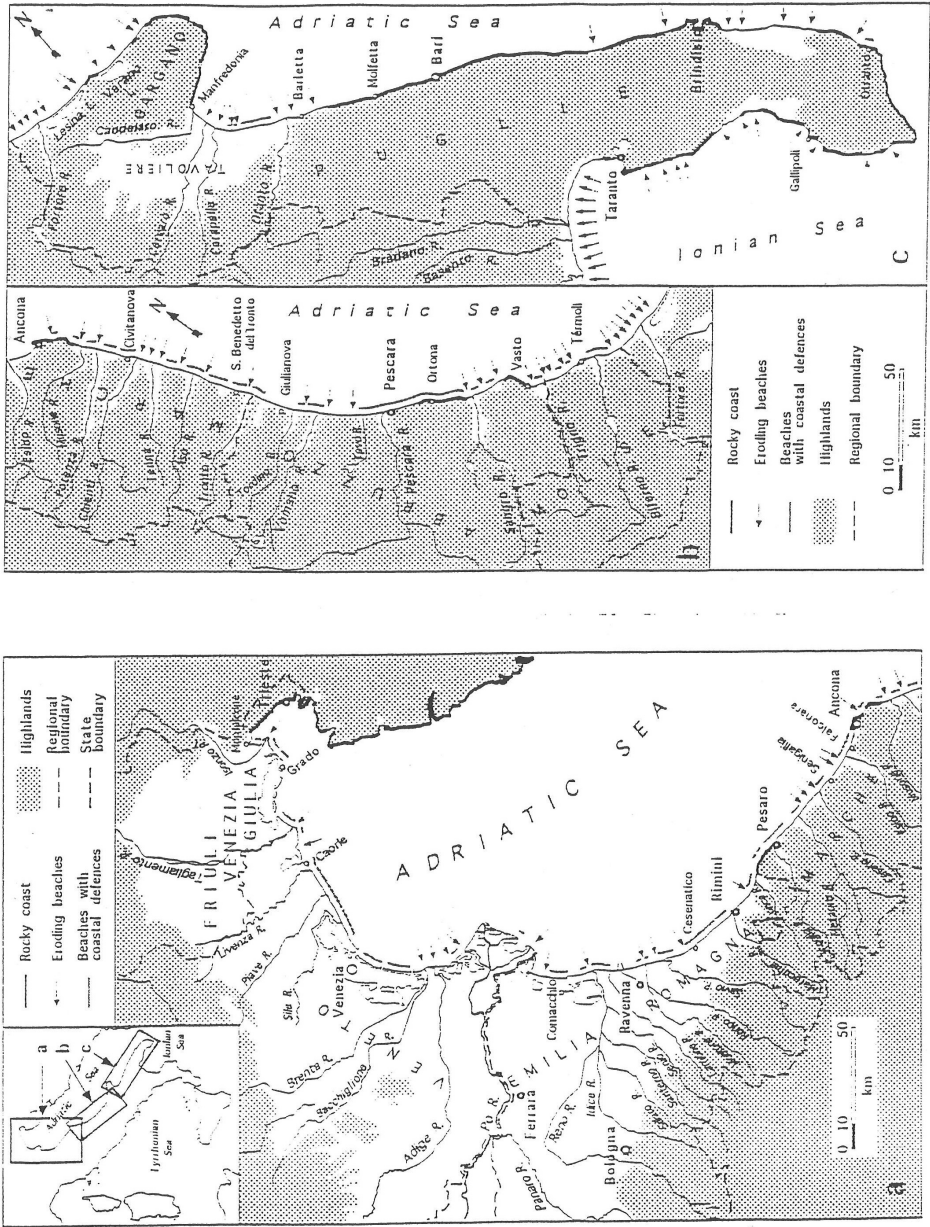


Fig. 2 – The situation of the Adriatic coast from Trieste to Otranto.

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## **THE ADRIATIC SEA EVOLUTION**

### The Pleistocene continental sedimentation

During the Pleistocene Würm glacial period about 20,000 years B.P. the Adriatic Sea level was from 90 to 130 m lower than the present and the coastline was about 300 km further south (fig. 1) leaving an emerged plain in the northern part of the Adriatic region. The Late Pleistocene continental complex is formed mainly by interbedded layers of clay, sand and peat; the continental origin of which is confirmed by the textural characteristics of the sediment layers and their paleontological contents. Important: studies by Bortolamiet *al.* (1977) on pollen, obtained from samples from different cores in the Lagoon of Venice and the Lower Po Valley, provided important information on the subsidence and climatic fluctuations in the northern Adriatic region. Their study briefly indicates:

- 1) following a continuous subsidence and sedimentation rate of about 1.3 mm/yr from before 40,000 to 22,000 years B.P., the least glacial peak, the sedimentation rate increased drastically to at last 5 mm/yr, probably caused by an accelerated downward movement of the basin, i.e. an isostatic effect;
- 2) a sedimentation gap ends the Pleistocene (18,000-7,000 years B.P.), and
- 3) an episode of emergence that corresponds to the compaction and overconsolidation of a clay layer considered as an indicator of the Holocene/Pleistocene boundary.

Bortolami *et al.* (1977) also found that the Pleistocene peat samples consist of the same type of Cyperaceae peat throughout the stratigraphic column indicating that the growth conditions, i.e. the hydrologic situation, must have been approximately the same during each period of peat development. Furthermore the authors suggest that a good correlation between age: and depth of the sediments implies that the sedimentation was strictly related to the subsidence of the basin floor.

Palynologic analyses gave important indications on the climatic variations and on the related vegetational phases for the time span between 40,000 and 18,000 years B.P.

A study by Bortolami *et al.* (1977) on pollen from peat samples from the Northern Adriatic basin gave a C14 date of 39,000 B.P. and indicates the following five climatic phases:

- (1) a Gramineae steppe period with *Juniperus*, *Artemisia*, *Ephedra* and some scattered pine trees indicating a cold and dry climate;
- (2) sixty percent increase in tree pollen percentage such as oak forest elements, traces of beech (*Fagus*), fir (*Abies*), pines (*Pinus*), birch (*Betula*) and spruce (*Picea*);  
between 38,000 to 34,000 years B.P. could be attributed to warmer and more humid conditions with some climatic changes within the same period.
- (3) with the occurrence of steppe vegetation such as Gramineae, Chenopodiaceae and few pines at 33,000 years B.P. a change to cold climate could be recorded;
- (4) between 32,000 and 23,000 years B.P., 50% increase in pine pollen with fairly high value for Gramineae, *Artemisia*, *Ephedra* and *Juniperus* indicates an open pine forest in the steppe with a dry climate. But between 31,000 and 29,000 years B.P. more humid condition were developed as indicated by the presence of oak (*Quercus*), elm (*Ulmus*) and poplar (*Populus*), and
- (5) a steppe type vegetation with up to 70% Gramineae, *Artemisia*, *Juniperus* and *Chenopodiaceae* characterized the: 22,000-18,000 years B.P. period with very dry and cold climate.

The authors also report a striking resemblance, despite the great distance, when they correlate the vegetation phases of the Venetian region with those from other locations in the Mediterranean area.

#### Pleistocene emergence

The Pleistocene period ends with a phase of no sedimentation (18,000-7,000 B.P.) in the Venetian lagoon. During the final phase of the Pleistocene period the shallow argillaceous deposits are drained, compacted and oxidized to form the overconsolidated levels known in the Venetian lagoon as “caranto” and representative of the Holocene/Pleistocene limit. The lack of sedimentation corresponds to the beginning of the deglaciation, the Flandrian transgression.

## The Flandrian transgression

With the climate improvement that started about 17,000 B.P. and reached its maximum about 6,000 B.P., the sea level began to rise and the coastline moved progressively northwards over the Adriatic palaeoplain until it reached approximately the present position about 6,000 B.P. That period was characterized by an intense and prolonged alluvial phase. Wave motion and sea current reworked and dispersed the fluvial sediments carried to the sea.

## Recent climatic variations

In addition to the described long-term climatic variations during the geological times, we have record of recent time's short-term climatic fluctuations. At the end of the last century, Brukner (1890) published a study pointing out a sequence of climatic fluctuations based on the comparison of meteorological data which resulted similar, for the same period, in different parts of the Northern Hemisphere. Using geological, geomorphological, glaciological, palaeobotanical, archaeological and historical investigations, it has been possible to reconstruct the sequence of climatic variations with accuracy for the historical times.

For the last 3,000 years, five cold and humid periods have been recognized that had a great impact on the Mediterranean basin. The periods were: 1400-1300 B.C.; 900-300 B.C.; 400-750 A.D.; 1150-1300 A.D.; 1550-1850 A.D.

These cold/wet periods were alternated with warm/dry periods and they have been well identified by the dendrochronological curves. Within these "large scale" periods, small climatic fluctuations of 10-35 years continued with cold/wet and warm/dry cycles up to present time. The influence of these climatic changes on the environmental evolutionary trend is obvious considering the variations of the shoreline along the Adriatic coastal zone.

## The present day morphology of the Adriatic Sea

At the present time the Adriatic Sea may be divided into 3 parts from North to South:

- Northern Adriatic Sea from the Trieste gulf to the Ancona promontory;
- Central Adriatic Sea from the Ancona promontory up to the Gargano promontory;
- Southern Adriatic Sea from the Gargano promontory up to Otranto.

The Northern Adriatic Sea is comprised in the continental shelf. The bottom slope is oriented



to S-E with values 0,25-0,60 m/km up to the isobath 100 m at the southern limit of this part of the Adriatic Sea. The velocity of sedimentation is about 4 mm/year. The main part of sediment yield is due to the Po river.

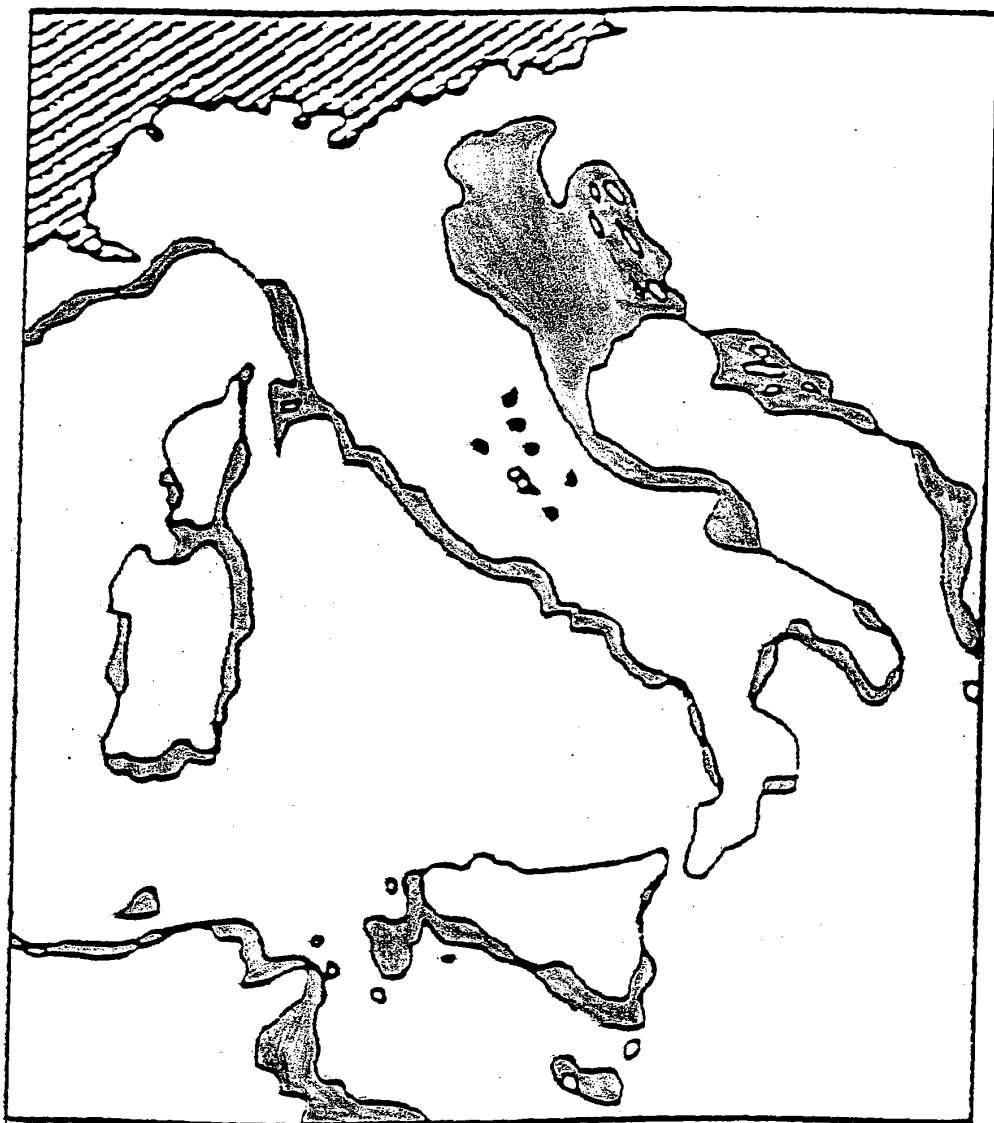
The central Adriatic Sea is again comprised M the continental shelf, but with a bottom slope from 0,75 to 12 m/km. It is characterized by some relieves, sometime emerged to give isles, and by a large depression (the mesoadriatic depression) formed by three small basins oriented NNE-SSW with depth around 270 m. This depression is recognized like the emerged border of the Po paleoplain during the upper Pleistocene.

The Southern Adriatic Sea is completely different: it is divided in three physiographic units: the continental shelf, the continental slope and a bathial plain at the border with the Ionian Sea.

The continental shelf extends up to the depth of 180 m. The continental slope, in the superior part, is interested by submarine canyons and valleys. In the inferior part of the continental slope there are some seamounts and the major of them is the Dauno seamount (-m 725).

After the inferior limit of the continental slope (-1150 m) the bathial plain extends with the maximum depth of 1216 m and bottom slope inferior 3 m/km.

A ripid channel, maximum depth 800 m, gives the connection between the southern Adriatic Sea and the Ionian Sea.



Würmianglacial areas.



Areas submerged during Flandrian transgression

Fig. 1 —The Upper Adriatic Palaeoplain during the Würmian.

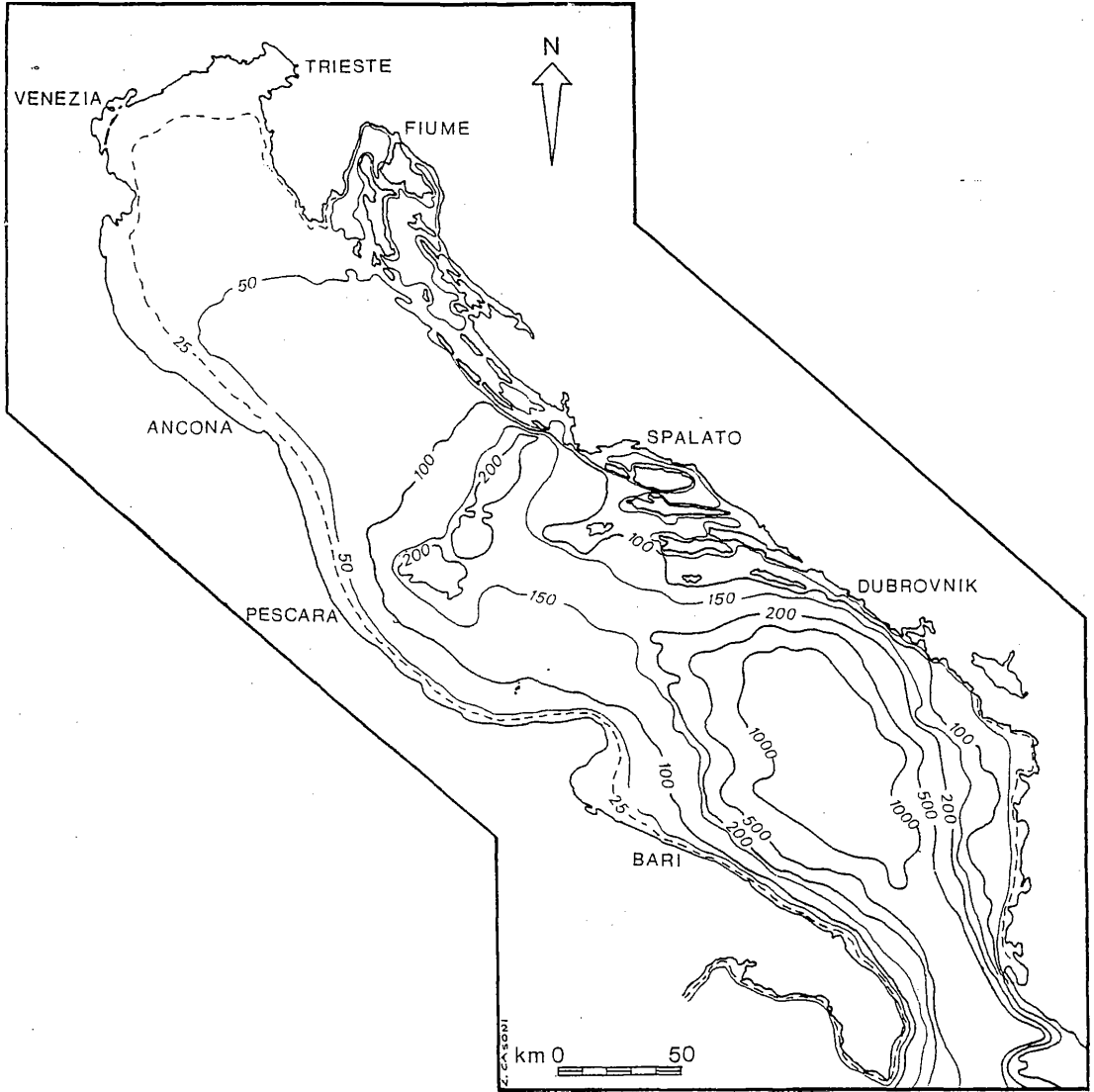


Fig. 2 — Bathymetric map of the Adriatic Sea

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**GEOGRAPHICAL DISTRIBUTION OF THE ECO-ENVIRONMENTAL IMPACTS  
CAUSED BY HUMAN ACTIVITIES, IN RIVER DELTAS & ESTUARIES, IN ITALY AND  
GREECE**

Abstract: Direct consequences of the human role, where human activity affects river channels, deltaic ecosystems and lagoons through engineering works, which are in a position to disrupt the environmental balance of littoral “dynamically developing” ecosystems, have been long recognized in many Mediterranean coastal areas in Italy and Greece. This work deals with the geographical distribution of the eco-environmental impacts caused by human activities, in river channels, Deltas and estuaries, such as those of the rivers Po, Adige, Bacchiglione, Brenta, Sile, Piave, in North-eastern Italy and Acheloos, Arachthos, Louros, Inoi, in Greece.

Keywords: Coastal environment; human activities; environmental impacts; Acheloos; Arachthos; Louros; Po; Venice lagoon.

### Introduction

The intensiveness with which the natural resources and especially the river channels, deltaic ecosystems, lagoons and the coastal areas are exploited, in many cases is also related to the engineering works (dam construction, diversion of river channels, construction and operation of harbors, deepening and creation of canals, swimming and sports facilities, etc.), as well as with constructions for the protection against erosion phenomena of the coast and all the abovementioned constitute the most significant burden to the geomorphology of the coastal zone. The size and the type of those changes that are seen in the coastal environment and especially in the geomorphological processes and the distribution of the deposits, mainly caused by the constructions of these “development projects”, are directly correlated with the hydrological, geological, geomorphological, geotechnical, oceanographic and climatic conditions of the area, as well as with the specific characteristics of the construction, mainly its location as well as its shape and size and the type of its foundation.

## Materials and methods

### *Geographical setting of the study areas*

This study focuses in four coastal zones which have undergone alterations due to human activities in the watershed of the rivers or on their coastal zones. These areas are found in North-eastern Italy and Greece and especially: a. Po river Delta and the complex of lagoons area (North-eastern Italy), b. Adige, Bacchiglione, Brenta, Sile and Piave rivers and the complex of Venice lagoon area (North-eastern Italy), c. Acheloos river Delta and the complex of lagoons area (Aitolokarnania, West Greece), d. Arachthos river Delta and the complex of lagoons area (Epirus, West Greece), e. Estuary of Louros river (Epirus, West Greece) and f. Estuary of Inois river (Haradros river) (Attiki, Central Greece).

### Investigation method

For the depiction of the condition of the natural environment and especially the geomorphology of the under study areas, there were used data collection involved review of existing reports, contemporary and older topographical maps, geological and oceanographic maps, hydrological data and aerial photos various years and scale as well as satellite images (Landsat).

## Results - Discussion

Eco-environmental impacts, geomorphological evolution and geomorphological changes caused by human activities

Human activities, which are able to disrupt the environmental balance on the coastal zone and the fragile natural ecosystems are: dam construction, diversion of river channels, construction and operation of harbors, deepening and creation of canals, swimming and sports facilities, sand extraction from river beds, uncontrolled watering from surface water tables, uncontrolled pumping of underground waters, e.t.c. Following that, we refer to the most important alterations -impacts/changes- that are noted to the deltaic ecosystems under investigation, which show these impacts, which are (C.E.C., 1999; US-EPA., 1999): 1. Alterations to the fauna, the flora and the natural ecosystems, 2. Alterations to the landscape, 3. Land use alterations, 4. Alterations to the surface

and underground waters and 5. Alterations in the geomorphology and the hydro-geomorphological processes. More detailed data concerning the eco-environmental and geomorphological characteristics, the geomorphological evolution and the main human activities of each area is given below:

#### Po river Delta and the complex of lagoons area (North-Eastern Italy)

The Po river Delta, in the Adriatic sea, is the extreme manifestation of the complex morphological events, which in the arc of about one million years have from the beginning filled the vast area enclosed by the Alps and the Apennines with sediments, thus constructing the Po valley, about 34,000 Km<sup>2</sup>, that extends into the Adriatic sea, giving rise to a projection of the delta. Through a very long, chronological sequence of maps from 1600 up to the present day, the morphological evolution of the Po River expansion into the sea and the seafloor can be followed. A continuous and conspicuous development seaward of the coastline had occurred for three centuries; a lower rate of prograding is observable starting at the beginning of 1900. This low steadily increase due to the diminished sediment yield (partly due to man's intervention) is evident in the 1953 survey. In the entire delta, and mostly in the southern coastal section, a regressive process became dominant, clearly showing an inversion in the trend (Ciabatti et al., 1984). In 1500 the southern Venetian lagoon was on the verge of being filled-in, jeopardizing port activity. To avoid this, the Venetian Republic in 1599 began the construction of the 7 km long canal, "*Taglio di Porto Viro*", to divert the Po to the South. This hydraulic work, completed in 1604, accomplished its aim and thereafter the Po Delta began to take on its present configuration with an accretion velocity toward the south much greater than the previous one (Marabini, 1985a).

The comparison among the shorelines points out the main advancing from 1600 up to 1750 and 1820 evidencing the lower rate of increase after this period and before interference of human activity. Comparing the width of the strip, in which the cusped deltas develop, with the remaining distance to the sea, we immediately have an idea of how different the rate of growth was before and after 1600. In fact, the mean velocity increase from the Etruscan period (about 6<sup>th</sup> century BC) up to 1600 is estimated about 450 m/century. For the last 350 years instead, considering the 25 km, which separate the 1600 shoreline from the present one, it is about 7 km/century (Marabini, 1985b). The different rate of advancement in the different periods can be explained considering climatic changes, the main factor before the role of human intervention. In synthesis of the above that: a. the natural tendency of the river Po has always been to develop its northern branches, while the southern branches have

always tended to be less important; b. after the construction of the “*Taglio di Porto Viro*” canal the accretion of the Delta was southward and the velocity of increase became 20 times greater than the average one of the ancient period; and c. the present shape of the delta is more the result of human intervention than natural evolution.

Adige, Bacchiglione, Brenta, Sile and Piave rivers and the complex of Venice lagoon area (North-eastern Italy)

The rivers “Adige”, “Bacchiglione”, “Brenta”, “Sile” and “Piave”, which during the past have been discharged inside the lagoon of Venice have already been diverted by human intervention and are now discharged into the Adriatic Sea. Venice lagoon was created around 6,000 years ago as part of a complex of lagoons, in the low coastal areas of Emilia-Romagna and Venezia (North-eastern Italy). Around the year 1000 AD, occupied the same position today, and the movement of surface water occurred through eight natural openings, rather than the current three, which enable communication with the sea. The river bodies Adige, Bacchiglione, Brenta, Sile and Piave, which during the past have been discharged into the lagoon of Venice offered significant quantities of fresh water and sediments, especially during periods of flooding. A considerable part of the complex of lagoons (Venice lagoon) has disappeared, after intense anthropogenic interventions, which consist primarily in the diversion of the main beds of rivers and torrents, creation and deepening of navigation channels, interventions that occurred both during the historical times, and in modern times (Carbognin et. al., 1984, 1985). In particular, during the period 1300-1800 AD, for defense and commercial purposes, diversion projects of the river bed of the rivers Adige, Bacchiglione, Brenta, Sile and Piave, were built which discharged into the Venice lagoon, in order to discharge these rivers outside the lagoon and prevent the filling with sediments, the result was the intensification of erosion phenomena of the coastal zone.

Today, in comparison with the past, the area of the lagoon of Venice is smaller and deeper. At the same time, seriously threatened by the phenomenon of high tide, called “*acque alte*”, recorded already from the beginning of 1900, which, after the year 1950, has grown significantly in terms of incidence, particularly during the stormy waves of the winter season, result in frequent flooding of inhabited islands, that exist within the lagoon, including the cities of Venice and Chioggia (Carbognin et. al., 1985).



## Achelous river Delta and the complex of lagoons area (Aitolokarnania, West Greece)

This site includes Achelous river mouth to the Ionian sea, the delta plain, the delta front, the prodelta and the lagoons system Mesolongi-Aitoliko. Achelous, is the biggest river of Western Central Greece, the first in water contribution and the second in length, found in Greek territory, with a total length of 220 km. It drains an area of almost 6.226 km<sup>2</sup> and contributes significant amounts of river waters and suspended material/sediments in the lower area of discharge. Achelous delta is a very dynamic system influenced primarily by fluvial and marine processes. Some of the delta plain features have been changed several times during the past decades (Sabot, et al, 2002).

On the main river channel of Achelous has built and operates many hydroelectric dams of Public Enterprise of Electricity (Kremasta, Kastraki, Stratos I & Stratos II). As a result, the Achelous river network shape, the valley floor morphology and the Delta has presented significant changes caused by the dams (Kremasta, Kastraki, Stratos I & Stratos II, Sykia & Mesochora).

Comparing the aerial photos, dated in 1960, and the satellite images of 2000, many changes of the coastline, the river mouth and the land use have been observed. Prominent changes concerning the fluvial environment, such as abandonment of the old drainage system (ox-bow lakes, old delta mouth) have been mapped. Also an expansion of the agriculture land and a decrease of the wet ground are observed (Vassilopoulos et al, 2005). The shape of the deposition tongue in Achelous river mouth at the west part of the area has been eroded; consequently it appears to be more elongated nowadays. Moreover, the shape of the coastline has been altered during those years due to wave and the current action. The delta front has also been extensively modified in the past decades (Vassilopoulos et al., 2005).

## Arachthos river Delta and the complex of lagoons area (Epirus, West Greece)

River Arachthos drains an area of 1.850,85 km<sup>2</sup>. It contributes significant amounts of sediments (around 2.900.000 m<sup>3</sup>/year), to the low lying area of discharge, due to the presence of erosion prone flysch in its basin (Mertzanis, 1992; Poulos and Chronis, 1997; Poulos et al., 2008). In the area of discharge of the estuaries of Arachthos and its neighboring Louros river, an extended complex of wetlands (lagoons and deltas), has been created. The wetlands area and the estuaries of Arachthos river to the gulf of Amvrakikos, located south of the town of Arta, in Ipiros area.

On the main river channel of Arachthos has built and operates the hydroelectric power dam “Pournari I”, during the period 1973-80, which is used for coverage of irrigation and potable water supply and flood protection in the region and the dam “Pournari II”.

After studying the temporal evolution of the coastal area and of the Delta of the river Arachthos, one can see the overall tendency of the sand barriers to shrink, and a tendency of regression of the coast line to the west part of its estuaries until Koronisia, with the exception of the occurrence of some local phenomena of advance at the mouth of the river. This general tendency of regression follows the deprivation of some volume of sediment from the area (around 2.900.000 m<sup>3</sup>/year), due to the Pournari I dam, but it is also due to the natural movement of the Delta towards the east. This tendency, for at least as far as the part of the sand barrier which connects Koronisia with Fidokastro is concerned, has been set back in the last 20 years when its largest part was converted to a road with the known necessary procedures, such as supportive-anti erosion works (water breakers, large limestone concrete rocks, rockfill dams, e.t.c.). More specifically, ever since the decade of 1960, when we had the construction of the first levees for the protection from floods, the irrigation channels and the drainage pits, in the area of the Delta of Arachthos, we have started to experience the disturbance of the balance of the coastal area (Mertzanis A., 1992).

#### Estuary of Louros river (Epirus, West Greece)

Louros river drains an area of 685.50 Km<sup>2</sup>. Due to the calcareous nature of the base of its basin, this river does not accept significant amounts of sediments which could result in apparent differentiations of its delta shape, at least during its recent geomorphological evolution (Mertzanis, 1992). On the main river channel of Louros has built and operates the hydroelectric dam “Louros”, during the period 1954-63. As a result, the Louros river network shape and the valley floor morphology has presented significant changes due to hydroelectric dam; Louros; (Mertzanis A., 1992; Poulos and Chronis, 1997; Kapsimalis et al, 2005; Poulos et al, 2008). Changes in the delta and the coastline are negligible because of the limestone composition of geological substrate in the Louros watershed and low particulate matter/sediments production.

#### Estuary of Inois river (Attiki, Central Greece)

This site includes the mouth of Inois river to the Marathonas bay in the northeastern coastal area of Attica. Inois is one of the biggest rivers of Attica. It drains an area of almost 177.2 km<sup>2</sup> in northeastern Attica and discharges at Marathonas bay (Marathonas gulf). On the main river channel of Inois has built and operates the water supply dam “Marathonas”. As a result of the dam construction, the Inois riverbed has presented significant changes to its network shape. In addition, a significant retreat of the

shoreline (~100 m) near the Inois river mouth during the last 120 years, may be caused mainly by: 1. the drastic reduction of riverine sediment supply due to the construction of the Marathonas dam, in 1929; and 2. The sand extraction from the lower course of the riverbed (Seni et al., 2004). Erosion in this coastal zone is still active, and in spite of the presence of some protection measures (i.e. sea walls, artificial nourishment), the erosion rate is likely to increase because of the prospective rise of the sea level (Maroukian et al, 1993; Pavlopoulos et al, 2002, 2006; Seni et al, 2004). Currently, erosional phenomena have been observed to the south of the mouth of river Inois, whilst to its northern part not significant changes have been recognized so far (Poulos et al, 2004).

## Conclusions

Regarding the geographical distribution of the eco-environmental impacts caused by human activities in river deltas & estuaries, in Italy and Greece, the conclusions mentioned briefly below: a. The study of the eco-environmental impacts and the evolution of the deltas & estuaries of the rivers Acheloos, Arachthos, Louros, Inoi, in Greece, showed that the balance of these dynamic ecosystems changed mainly caused by large dams and reservoirs construction and operation. b. The destabilization of the balance of the coastal zone, the decrease of the rate of the advance of the shoreline at the Delta of Po river and the sand barriers of the lagoons and in some sites the intensification of erosion phenomena as well as local phenomena of retreat of the shoreline are the result of human interventions in combination with climate change. These phenomena are mainly due to the limitation of the natural input of sediments in the Delta area and in the coastal zone which mainly concern the construction of anti-erosion works in mountainous catchment basins (small dams, erosion protection works for torrents, etc.) and sand extraction from the river bed (pits for obtaining sand, clay etc) as well as the uncontrolled pumping of underground waters. Also the construction of the canal, “*Taglio di Porto Viro*” and the artificial diversion of the Po to the South, changed the balance of the coastal zone and c. The artificial diversion into the Adriatic Sea of the rivers Adige, Bacchiglione, Brenta, Sile and Piave, which during the past have been discharged inside the lagoon of Venice, changed the balance of the coastal zone and the Venice lagoon.

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## **SEDIMENT TRANSFER AND GEOMORPHOLOGICAL EVOLUTION IN RIVER SYSTEMS & COASTAL ZONES IN ITALY, ROMANIA AND GREECE**

**Abstract:** In many Mediterranean coastal areas, has been observed that human activities-engineering works, such as large dams and reservoirs construction (hydroelectric power dams, irrigation dams and water supply dams), channelization (drainage pits and drainage dams, deepening and creation of canals), arrangement and redirection of the main beds of rivers and torrents, construction of jetties in the coastal zone and anti-erosion works (water breakers, large concrete rocks, etc.), motorway and railway line in operation or under construction, as well as other human interventions and activities (sand extraction from river beds, intensification and development of agriculture projects and industrialization, infrastructure works, embankments, exsiccation, deforestation, etc.), may seriously affect the sediment transfer and the environmental balance of inland and coastal environments (wetlands, lagoons, Deltas, estuaries and coastal areas). This work deals with the comparative account and evaluation of the impact to the environment and especially the changes to the sediment transfer and geomorphological evolution in river systems & coastal zones in Italy (northern Adriatic coastal zone), Romania (Danube river Delta) and Greece (Nestos and Spercheios river Delta, Western Peloponnesian coastal zone) caused by the human activity.

**Keywords:** Coastal environment; Danube river; human activities; dams; environmental impacts; Nestos river; river sediments; Spercheios river.

## Introduction

The specific geological, hydrological, geomorphological and soil characteristics as well as the extensive biodiversity and productivity that characterize some catchment areas, deltas, estuaries, lagoons, etc., in Italy, Romania and Greece, are the main factors responsible for the intense human activity in these areas. In these areas both in the delta area and in the coastal zone, the presence of human activity as well as infrastructure works are intense and in some cases, may seriously affect the sediment transfer and the environmental balance of inland and coastal environments. Moreover, the presence of human activity is equally intense in the drainage basins which supply the wetlands with water volume and sediments, which are an important parameter for the conservation of those wetlands and the extremely dynamic environments. Also, an important factor in the dynamic equilibrium of the coast, is the wave action generated on the sea surface by the winds.

Human activities in the study areas, was of different aims in each location, but it all resulted in the disruption of the natural environment and alteration of the dynamic evolution of the hydro-geomorphological processes which has led to the creation of an “artificial” environment, controlled to a great extend by human power and which in turn, in the long term re-strengthens and re-enforces the possibility of environmental destabilization. Serious problems appear in the natural environment, especially when these projects are located in such a position to destabilize the environmental balance of the area and to alter the natural evolution of the parameters that are directly correlated with the creation, preservation and development of “fragile” and “dynamically developing” ecosystems such as those under investigation.

## Materials And Methods

### Geographical setting of the study areas

This study focuses in five coastal zones which have undergone alterations due to human activities in the drainage basins of the rivers or on their coastal zones. These areas are found in Italy, East Romania and Greece. Specifically, the areas under study are located: a. in the Northern Adriatic coastal zone of the Marche region in the between Gabicce promontory and mouth of Tronto river (Adriatic Sea/North-eastern Italy), b. in the Western Black Sea coastal zone, in the between southern of Sfantu Gheorghe distributary and the border between Ukraine and Romania/ Danube river Delta (East Romania), c. in the Nestos river Delta in East Macedonia & Thrace (Thracian Sea/ East Greece), d. in the Spercheios river Delta (Maliakos gulf/Central Greece) and e. in the Western

Peloponnesian coastal zone, in the between Katakolon and Kiparissia (Kiparissiakos gulf - Ionian Sea/Western Greece).

#### Investigation method

For the depiction of the condition of the natural environment and the assessment of the impact caused by certain human activities to the natural environment and geomorphology of the areas under study and especially, to the hydro-geomorphological processes in the coastal zones, shorelines, deltas and watershed, have been used data collection involved review of existing reports, contemporary and older topographical maps, geological and oceanographic maps, hydrological data and aerial photos various years and scale as well as satellite images.

#### Results - Discussion

##### Geomorphological evolution

Some of human activities, which are able to disrupt the environmental balance on the coastal zone and the fragile natural ecosystems are: large dams and reservoirs construction, construction of irrigation canals and drainage pits, diversion of river channels, intense construction of coastal defense structures, construction of jetties and harbors, deepening and creation of canals, sand extraction from river bed, uncontrolled watering from surface water tables, uncontrolled pumping of underground waters, etc. Following that, we refer to the most important impacts/changes, that are noted on the coastal zones and deltaic ecosystems under investigation, which show these impacts, which are (C.E.C., 1999): 1. Alterations to the fauna, the flora and the natural ecosystems, 2. Alterations to the landscape, 3. Land use alterations, 4. Alterations to the surface and underground waters and 5. Alterations in the geomorphology and the hydro-geomorphological processes. More specifically, the aforementioned human activities have a significant impact on the natural environment, geomorphological evolution and the hydro-geomorphological processes of some deltas, estuaries, river mouths, lagoons, fen, etc., which are extremely dynamic environments, such as for example, those which constitute the object of this study. More detailed data concerning the eco-environmental and geomorphological characteristics, the geomorphological evolution and the main human activities of each area is given below:

Northern Adriatic coastal zone of the Marche region in the between Gabicce promontory and mouth of Tronto river (Adriatic Sea/North-eastern Italy)

The dynamic evolution of this coastal zone is quite simple. The sources of sediments, reworked by the waves and distributed along the shore by the longshore current from south to north, are the material transported by the rivers to the sea and the material derived from the landslides of the cliff from Gabicce to the Ancona promontory. In the past the large sediment yield from the rivers to the sea indicates a general advancing of the shoreline in the northern sandy littoral up to Gabicce, with the maximum values corresponding to the rivers outlets. The general advancing of the shoreline for the whole area, in spite of some local regressions of the cliff in the south, was continuous from the 1600 up to the beginning of the XXth century. After the first decade of the 1900s, only some sectors continued to increase, but at a significantly slower rate than in the past. The comparison of the shoreline variation from 1944 up to the present day shows a rapid increase in the rate of erosion with a regression of the shoreline between 1954 and 1980. Also of significance is that the major points of regression correspond to the river mouths. The comparison of the situation between 1980 and 1999 shows a slower rate of regression and a modest advancing of the shoreline. This situation is due to the intense construction of coastal defense structure along the entire Marche coast after 1980 (Angeli et. al., 2010; Marabini and Veggiani 1991).

Danube river Delta-Western Black Sea coastal zone, in the between southern of Sfantu Gheorghe distributary and the border between Ukraine and Romania (East Romania).

The channel of the Danube first divides into two distributaries: Chilia and Tulcea. It should be noted that Sulina, the middle distributary of the Danube Delta, has been significantly changed by human activities over the past 150 yr. These include engineering works in the second half of the 19<sup>th</sup> century, when the channel was transformed for navigation and the construction of jetties which nowadays extend 8 km seawards. These interventions have strongly affected the natural processes of the Black Sea coast near the Sulina mouth. To the north of the Sulina mouth, the natural mild erosion has been reversed in the area close to the jetties where accretion is occurring, while southwards the greatest erosion rate along the entire Romanian coast, of more than 20 m/yr, has been recorded. Sediment accumulation in the northern part of the mouth is also huge and has brought to the creation and swift elongation of a sediment spit in several decades. Furthermore, the damming of the Danube River for hydroelectric purposes has drastically reduced sediment discharge to the coast (Ungureanu and Stanica, 2000; Stanica et. al. 2009). Currently more than 30 dams span the Danube (Pringle et. al. 1997) and there are hundreds of dams along its tributaries.

Nestos river Delta in East Macedonia & Thrace (Thracian Sea/East Greece)



In this site, the deltaic plain has suffered human works all through the last half of the 20<sup>th</sup> century. The period from the year 1945 onwards, is a period in time where appear the early human interferences in the area; drainage and irrigation canals. In 1983, started the engineering works for the construction of the hydroelectric dams “Thissavros” and “Platanovrissi” on the main river channel of Nestos. Also have appeared retreat tendency of the shoreline at some positions on the coastal zone. The artificial diversion to the east by 4 km of Nestos river channel and the realignment of the lowest course of the river, resulted in erosion phenomena in a part of Nestos river in the west (Akroneri), and these sediments are moved west-northwest along with the waves and the coastal currents (Psilovikos et al., 1986).

Spercheios river Delta (Maliakos gulf/Central Greece)

Spercheios river drains an area of 1907,2 Km<sup>2</sup>. It contributes significant amounts of brought materials in the lower area of discharge, due to the presence of erosion prone flysch in its basin. These materials deposit and enrich the plane of Lamia and the Delta (Zamani and Maroukian, 1980). It should be noted that a significant element as far as the changes in the geological-geomorphological structure and the hydro-geomorphological processes of the delta area is concerned, is the rearrangement - partial diversion to the north of the main bed of the Spercheios river. The result of this diversion was the creation of a new Delta in the site of the new position of discharge of the river in the gulf of Maliakos, while according to indications, the rate of displacement of the coast line towards the sea at the old Delta has been slowed down while the creation of conditions that will lead to the regression of the coast line in that location is impossible.

Western Peloponnesian coastal zone, in the between Katakolon and Kiparissia (Kiparissiakos gulf - Ionian Sea/Western Greece)

On the main river channel of Alfeios has built and operates the irrigation dam “Flokas” in 1983. Also, on the river channel of Ladonas, a tributary of Alfeios river, has built and operates the hydroelectric power dam “Ladonas”, during the period 1950-55. As a result, have appeared regression tendency of the coastline (shoreline) at the estuaries and at some positions on the coastal zone (Mertzanis et al., 2011). In the Alfeios river mouth and at the coastal zone at the north-west (Spiantza) and south-east (Paralia Epitalion), the regression phenomena of the coast line has reached about 25 m, for the period from 1960 to 1984, with severe damage to houses and buildings in some coastal areas

(Spiantza, Paralia Epitalion, etc). The speed of the coastline regression is estimated about 1 m/year, and in some places at the north-west coast, exceeds 2-3 m/year. The year 2010, the regression of the shoreline in some places has reached about 150-200 m (Ghionis et al., 2004).

Sediment transfer and established changes on the hydro-geomorphological processes of the coastal zone, caused by certain human activities

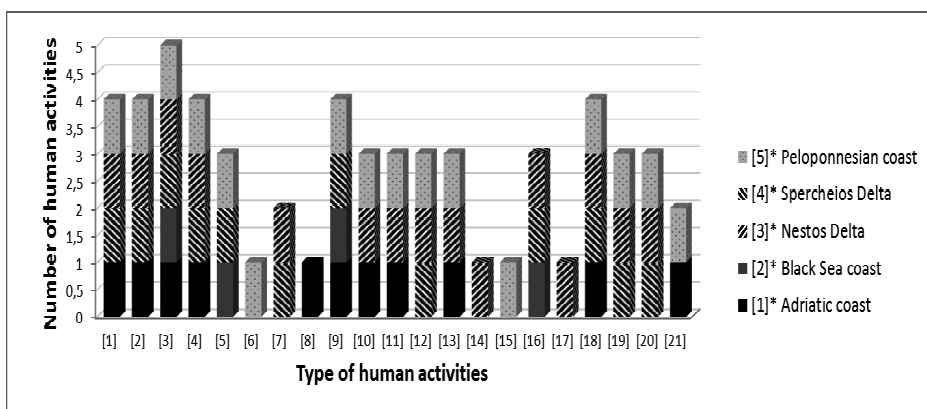
The intensification of some human activities such as those mentioned above (large dams and reservoirs construction, construction of irrigation canals and drainage pits, diversion of river channels, intense construction of coastal defense structures, etc), in the catchment basin and in the coastal zone of the areas under study, that took place since the '50s, have affected the natural coastal ecosystems, wetlands and the “dynamic” geomorphological systems which develop with relatively great speed. These impacts, depending on the type, the size and the operation and location of the intervention (Figure 1). “Dynamic” geomorphological systems of this kind are the areas of the estuaries and river deltas, coastal valleys, lakes, lagoons and fens which are subjected to intense variations as far as the “positive” or “negative” shift of the shoreline. This process is defined as “advance” or “retreat” depending on the capability of the rivers (material transported by the rivers to the sea, etc.), to supply the coastal area with sediments or on the inhibition of the supply of the coastal area with sediments, respectively.

The phenomena of “advance” or “retreat” of the shoreline can be attributed to human intervention or natural processes. These phenomena depend mainly on the potential of each region, to the deposition of sediments or their withdrawal from it, depending on the geomorphological and oceanographic characteristics of the terrestrial, coastal and marine area. Especially for the delta-lagoon-marine ecosystems, an important element is the rate of supply with water and sediments in the area but also important element is the qualitative data of the above mentioned characteristics. It is noted that those interventions that result in the alteration of this dynamic evolution of the geomorphological processes, usually lead to the creation of an “artificial” environment which to a great extent is man controlled, and which in turn in the long run resupplies and reinforces the environmental threats in the region (Mertzanis et al, 2011).

Noted that the destabilization of the balance of the coastal zones, the decrease of the rate of the advance of the coastline at the Deltas and the estuaries of some sites and the intensification of erosion phenomena as well as phenomena of retreat of the coast line, constitute a common factor for large parts of the coast of Northern Italy, East Romania and Greece, more so after the year 1950. This

situation does not comply with the general tendency of coastal zone accretion that characterized the 19<sup>th</sup> century and is mainly caused by human activities and especially to the construction of all sorts of projects big and small, which due to their nature and position, cause changes in the natural evolution of the landforms and the hydro-geomorphological processes or in some cases reduce the input of sediments in the coastal area. Following that, we refer to the most important human activities that have been identified in each of the five areas under investigation (Figure 1):

Figure 1. Cumulative chart of different types of human activities identified in the areas under investigation in Italy, Romania and Greece.



Source: Estimates of the study group and various literature sources and existing reports

Note: [1] Intensification and development of agriculture, [2] Construction of irrigation canals and drainage pits, [3] Deepening and creation of canals, [4] Construction of drainage - anti flooding protection works, [5] Construction and operation of large dams and reservoirs (hydroelectric dams, irrigation dams and water supply dams) on the main bed of the river (>15.0 m height or reservoir volume > 3.0 million m<sup>3</sup>), [6] Construction and operation of large dams and reservoirs (hydroelectric dams, irrigation dams and water supply dams) on tributaries of major river (>15.0 m height or reservoir volume > 3.0 million m<sup>3</sup>), [7] Intense construction of anti-erosion works in mountainous catchment basins (small dams, etc.), [8] Intense construction of coastal defense structures (seawalls, water breakers, groins, massive wall built out into the sea to protect a shore or harbour from the force of the waves, large quarried stones, specially shaped concrete blocks) - Intense construction of seawalls for the protection of the cliff, to avoid landslides dangerous for the railway line, [9] Construction of jetties, harbors, anchorages and moorings in the coastal zone, [10] Motorway in operation or under

construction, [11] National road work constructions or improvements on the national road network, [12] Opening up new agricultural and forest roads, [13] Railway line in operation or under construction, [14] Banking up - filling of lagoons or lakes with sediments, [15] Exsiccation - desiccation of lakes or lagoons, [16] Arrangement, redirection, total or partial diversion of the main bed of rivers and torrents, [17] Mining activities (quarries, mines) in the main bed or in the river catchment, [18] Sand and gravel extraction from river beds, [19] Uncontrolled watering from surface water tables, [20] Uncontrolled pumping of underground waters and [21] Intense urbanization of large coastal zones without regarding the natural environment.

## Conclusions

From the comparative evaluation of the areas under study in Italy (northern Adriatic coastal zone), Romania (Danube river Delta) and Greece (Nestos and Spercheios river Delta, Western Peloponnesian coastal zone), showed that the changes in sediment transport and changes in the geomorphological evolution of these areas, mainly due to human activities, climate changes and the action of the storm waves. The intense human activity and the engineering works such as construction of motorways and railways, construction of large dams and reservoirs, artificial diversion of rivers, construction of canals and jetties, intense construction of coastal defense structures, intense urbanization of large coastal zones, sand and gravel extraction from river beds, etc. in the coastal zone, deltaic area and in the catchment area of the rivers which supply water and sediments to the coastal zones of interest, have a negative effect on the dynamic of the coastal area. This intensification of human activities, mainly after the decade of 1950, in the drainage basins and in the coastal zone in some places in Italy, Romania and Greece and the climate change (in some of them), have affected the natural environment and hydro-geomorphological processes one way or another and to a different extend, depending on the type, the size and the operation and the location of the intervention or activities.

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**GEOMORPHOLOGICAL EVOLUTION AND COASTLINE CHANGE OF SANDWIP  
ISLAND, EASTERN GBM DELTA, BANGLADESH**

**Abstract:** The Lower Meghna River Estuary is a very dynamic estuarine system experiencing dramatic geomorphological changes of its offshore islands. Erosion and accretion rates are extremely high and the islands migrates southwards along with reducing the original sizes. An attempt has been made to study a time series of recent geomorphological changes in the shorelines of Sandwip Island using Landsat satellite imagery of 1978, 2001 and 2006 obtained from the Global land Cover facility (GLCF). The analysis showed, among other things, that the shoreline erosion is dominant in the south and south eastern parts of the island, while large new emerged parts are accreting in the north and north-western part of the island. The Island has accreted 3.8 km (maximum) and 0.7 km respectively in the northern and eastern part from 1978 to 2001. Image analysis also showed that the cliffs on the south and south-eastern parts have eroded respectively 1.8 km and more than 2.6 km over this 23 year period. The comparison of images captured between 1978-2006 shows that erosion is migrating towards the southern and south-eastern parts of the island.

**Introduction**

Due to its dense population, a wide and shallow continental shelf with complex coastal configuration with shallow bathymetry, Bangladesh has suffered enormous storm-related casualties along its 710 km long coastline where 28% of the population lives. In Bangladesh 62% of the coastal land has an elevation of up to 3 m where 86% is up to 5 m (Shamsuddoha and Chowdhury, 2007; Ahmed, 2011). The GBM delta front is strongly dominated by tidal processes: tides are semi-diurnal with a range of up to 6 m, and generate shore-normal tidal currents up to 0.3 m/sec (Barua et al., 1994). Barua (1990) notes that during periods of low river discharge, the eastern distributary channels (Hatia and Sandwip Channels) serve as flood channels. The delta has been growing both upward and seaward since its creation and geological evidence shows an average progradation rate of about 80-100 m /year. Now, most of the south-eastern lower parts of the delta do not have enough fluvial

sediment supply and are undergoing coastal erosion and submergence, threatening the existence of the delta, which hosts about 30 million inhabitants (Khalequzzaman, 1989).

The active delta, southeastern offshore of the Bengal shelf area is in and around the mouth of the Meghna (mouth of the Ganges), and the region is characterized by low and flat deltaic islands such as Hatia, Bhola and Sandwip, etc. The elevation of the islands is lower than 5 m, and most commonly 2-3 m. Additionally, the sediments making up the islands are very soft, unconsolidated silts and clays. Thus the landforms of the active delta are extremely changeable and are easily reshaped by, tidal action, river discharge and attack of cyclones (Umitsu, 1997). The current paper focuses on Sandwip Island, an eroding island in the Bangladeshi part of the delta. The objective of this study is to understand coastline evolution particularities, measure geomorphological change rates, produce useful information for the relevant organizations to control or attempt to reduce the coastal degradation and provide reference for the future similar coastal engineering study.

## Study Area

The area of interest is Sandwip Island, situated at the confluence of the Lower Meghna River Estuary (LMRE), is bounded by the Bamni river in the north, the Meghna river and Hatia island in west, Sandwip channel and Sitakundo sub-district in east and Bay of Bengal in the South (Fig 1). The island is eroding as confirmed by published work based on historical cartography (Barua, 1997). From 1913-1988 i.e. in 75 years, the island has reduced its area to about 50% of its original size. The rate of erosion was 200m/year between 1913 and 1960 and about 350 meter/year between 1963 and 1984. The causes of erosion are strong wave action during the southwest monsoon, high astronomical tides, frequent and extreme storm surges in the Bay of Bengal (Hegde, 2010). Accretion in some parts of the island has been coupled with erosion on other sides. The island's shape and area has been changing dramatically with an erosive trend in the south-western part and accretion in the north-western part.

Run off from the large catchments of the mighty Ganges and Brahmaputra, combined with the Padma river and from the Upper Meghna, the Lower Meghna River drains into the Bay of Bengal through western and eastern sides of Sandwip. River flow is characterized by a distinct seasonality, with variation from approximately 10,000 m<sup>3</sup>/s and 100,000 m<sup>3</sup>/s during the dry and monsoon seasons respectively (DHV, 2001).

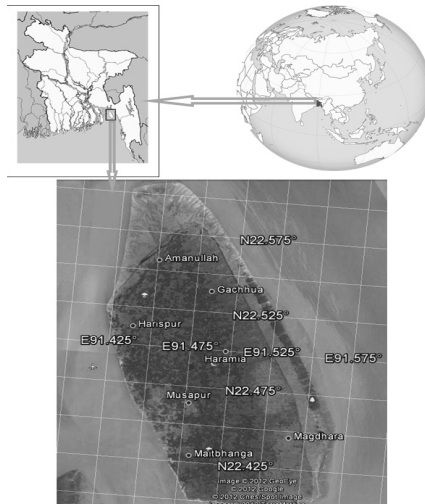


Fig 1: The target study area (Sandwip Island)

The island is exposed to a macrotidal regime with tidal variation in the range of about 3 to 6 m from Neap to Spring tides (Hayes, 1979). The flow distribution in the LMRE is characterized by the interaction between tides from the Indian Ocean and fresh water flow of the upper Meghan River. In the eastern part of the lower estuary, the flow is dominated by the tidal influence where as the western part is dominated by freshwater flow. Sandwip is surrounded by the tide-dominated East Hatia Channel, the Sandwip Channel, and the link channel between Hatia and Sandwio Channel (Barua, 1997). A prominent counter clockwise residual circulation ,which is very turbulent in nature,is present around Sandwip. The highest tidal current velocity of up to 4 m/s was observed in Sandwip Channel and upper reach of the estuary during spring tides and the rainy seasons respectively (KPED, 2003). Salinity distribution is mainly influenced by seasonal changes of freshwater discharge in the estuary. Saline water found around the island is almost well mixed with a strong stratification found only in the deep Sandwip Channel (Sokolewicz et al. 2007).

The region around the mouth of the Meghna (mouth of the Ganges and Brahmaputra) is an active delta, where the landforms are unstable and easily changeable by the action of huge water flow and tidal action. Landforms of the active delta are extremely low and flat. Sediments of the region consist of sandy or silty soft sediments (Umitsu, 1997). The Lower Meghna River (LMRE) is the highest in carrying sediment discharge amongst all the river systems in the world (Coleman, 1969). The main bed materials of the are silt and fine sand. A recent study revealed that about 700Mtons enters the lower part of the estuary forming new lands through accretions either laterally or vertically



of the shelf after that 1/3 of the sediment load is deposited in the flood plains of the upper estuary (Goodbred and Kuehl, 1999). But the net change in the sediment volume is small compared to total accretion to erosion for the LMRE. Overlaying the shoreline positions from the Lloyd survey in 1840 with a 1984 LANDSAT, Allison (1997) proved that erosion was dominant in the north-western part of Sandwip, whereby accretion was dominating the south-eastern part.

The morphological evolution in the LMRE has been very active due to the magnitude of hydrodynamic and sediment transport processes. Enormous mudflats have merged in the north-west of the island and new ones were created in the south-east. A general trend of southward island migration was clearly observed between 1913-1916 and 1988. Map comparisons by (Barua, 1997) showed that the average erosion rate on the northwest coast of Sandwip accelerated after 1963. It was about 200 m/year between 1913 and 1963 and about 350 m/year between 1963 and 1984. In a cross-sectional study he also revealed that erosion of Sandwip Island can be related to the simultaneous silting up of a deep channel and the development of a completely new channel nearby. The historical coastal changes of Sandwip Island are also well described in Umitsu (1997) who showed the southwards (seawards) migration of the island with extreme reduction of its northern side (almost 50% of the island) due to erosion from 1925 to 1970.

## Materials and Methods

Multi Spectral Scanner (MSS) of 1978, Thematic Mapper (TM) and Enhanced Thematic Mapper Plus (ETM+) of 2001 and 2006 Landsat orthorectified images covering the target island were used to assess coastline and morphological changes. The images are freely available from the Global Land Cover Facility (<http://glcf.umiacs.umd.edu/>). The images covering the study area are orthorectified in UTM zone 46N, WGS 84 datum. ILWIS, the free user-friendly raster and vector GIS software (v3.7) was used to digitize on screen the cliff base and the shorelines (land-water boundary). Ground truthing on the entire study area was conducted during a four-day visit in August 2012. The aim of the ground truthing was to observe the acting processes and interview the local people to obtain qualitative information about the status of the shoreline in relation to previous years.

## Result and discussion

According to our preliminary analysis, the northern and north-western coasts of the Island have been growing about 3.8 km (maximum) and 0.7 km in the eastern protected part from 1978 to 2001.

(Fig 2a). During the ground truthing visit to the accreted area it was found that the accretion started after 1991 (after the disaster of 29 April 1991 when cyclones washed out about 13000 people living on the island), and it has already extended about 3 km in the north-western part. The observation is contradictory with previous works (Barua, 1997; Allison, 1997) as those records revealed the extreme erosion of the north-western part from 1884 to 1988. It must be remembered that the MSS sensor has less spatial resolution than the TM sensor, but in any case the magnitude of change is so large that an error in the order of meters is acceptable. Our present image analysis also shows that the south and south-eastern cliffs had been eroded from 1978 to 2001 respectively of 1.8 km and more than 2.6 km during this 23 year period (Fig. 2a).

The image of 1978 and 2006 coastline comparison shows the destruction of erosion is migrating towards the south and south eastern part of the island. By this time (from 1978 to 2006) the south western part has already lost about 4 km where as the northern and north-western part continues to accrete (Fig 2b). This erosion caused several times inundation of villages and urban areas near the coast, generating a deterioration of the environment by washed out sediment and salinity intrusion. The current aspect of the northwestern, western and southern shores can be seen in Fig. 3. The comparison between the digitized images outlines an intense transformation of the coastline. A reason can be of the interaction between tidal energy and fluvial discharge due to circulation driven by the Coriolis Effect. Barua (1990) indicated an anticlockwise sediment motion in the area resulting primarily from the net export of sediments through ebb channels and net import of sediments through flood channels. The finer fraction of sediments is thus recycled back into the estuary.

The same kind of gyre is also produced by refracting waves (Barua and Kana, 1995). Therefore, northeastern flood channels may show a net aggradation through time. The generation of an erosive trends in the south and south-eastern part of the island is assumed to be due changes in the discharge flow pattern, together with changes in the tidal current regime, after the development of the Muhuri Project on the Feni river in 1985-86. The Sandwip channel has become isolated from the Meghna river estuarine discharge which was feeding sedimentation in the south eastern part of the island. On the other hand, the sediment carried by the lower Meghna river to the Bay of Bengal could now been trapped by the tidal influence and precipitate in the northeastern part and eastern part of the Hatia channel.

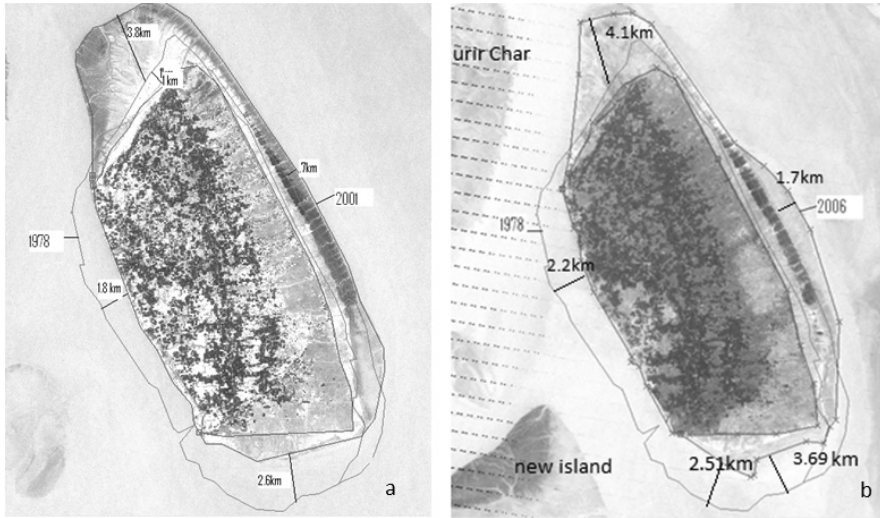


Fig 2: a), Shoreline overlay of 1978 and 2001, b) Shoreline overlay of 1978 and 2006

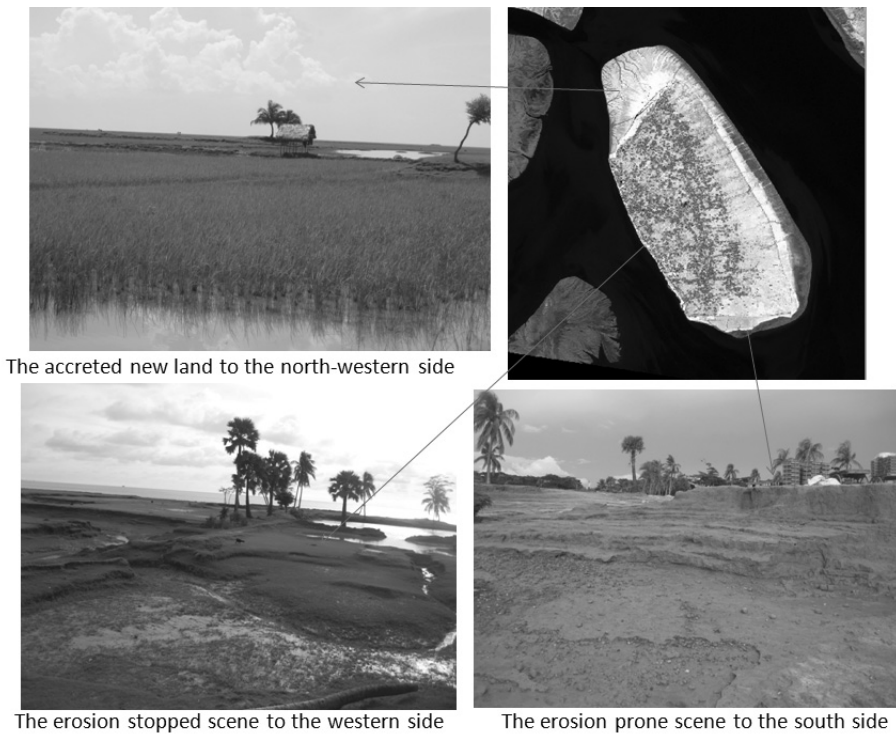


Fig 3: Three different environment of the Island in August 2012

## Conclusions

Accretion has resulted to be dominant in the northern part of the island. The erosion in the western part along the Hatia channel is almost stopped for the last 5-7 years. But the erosion has continued in the southern and south-eastern parts of the island which had been accreted in between 1916-1988.

The limitation of the research presented here is the variable resolution between MSS and TM Landsat datasets. Future analyses will include better resolution sensors like the SPOT generation and search for aerial photographs. The erosional trends and the migration of the erosion hotspots of the island have been changing very abruptly. Accurate topo and bathymetric information, sedimentation of the LMRE and the hydrodynamic behaviour of marine and fresh water in and around the island must be studied for a comprehensive understanding of the erosion-accretion patterns. The understanding of the island dynamics is prerequisite for a complete and effective management plan to restore occupation by the population and plan new land occupation by the government and relevant organizations. The work presented here has laid down the basis for future flood protection, preparedness and management of risks around the island. It is advisable that in the future the competent authorities will plan the development of early warning systems for inundation due to storm surges and cyclones; likewise it is being done at European level (Ciavola et al. 2011a and b).

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## **EPHESUS: REMOTE SENSING FOR COASTAL PROCESSES IN SOUTHERN BOHAI SEA - CHINA**

Abstract: Hydrological processes in coastal areas of the Southern Bohai Sea are highly impacted by morphological changes and mixing between continental fresh waters (surficial and groundwater) and marine waters. Natural factors combine with human perturbations such as excessive exploitation of natural resources. The effects of overexploitation are evident in coastal areas, considering e. g. salt contamination, land degradation, pollution and subsidence, which determine serious damages to the soils, freshwater resources as well as jeopardize the ecological system. The main purpose of the ongoing project “EPHESUS - Ecological and Physical Effects of the Surficial and groundwater exchanges between land and Sea” is directed to identify, assess and monitor the effects on coastal ecosystem, which is exposed to those hazards, in order to prevent further deterioration. In this work we present the rationale of the project and describe the satellite data and the methods of investigation which will be used.

Keywords: remote sensing, Yellow River Delta, coastal processes, land-use and land-cover, water quality.

### Scientific Rationale

The project “EPHESUS - Ecological and PHysical Effects of the SURficial and groundwater exchanges between land and Sea” is performed in the framework of Dragon 3 programme (2012-2016), which is a cooperation between ESA (European Space Agency) and the Ministry of Science and Technology (MOST) of the Popular Republic of China. Dragon 3 focuses on exploitation of ESA, Third Party Missions and Chinese satellite data for geo-science and applications development in land,

ocean and atmospheric applications. The Programme brings together joint Sino-European teams to investigate 50 thematic projects. The project EPHESUS will last four years and it was formally started at the Beijing Symposium, in June 2012. It aims to develop an integrated monitoring approach by satellite products, in situ measurements and hydrological models, and to provide detailed information for an understanding of hydro-morphogeological processes on coastal areas.

EPHESUS has been resulted from previous cooperation projects between Italian and Chinese scientific teams on the study of hydrologic processes in coastal ecosystems for the understanding of the relationship between continental and marine waters in the Yantai (China) and Venice (Italy) areas. These activities gave some basic results for the knowledge on the current conditions, but lack of specific information about the effect of hydrologic processes on the coastal ecosystem. So, within EPHESUS we will take advantage of using European and Chinese satellite data, provided in the framework of Dragon programme, integrating them with the outcomes of previous studies. The main purpose of this project is the identification of key parameters, which highlight the effects of seawater contamination and inland water discharges on the sea and are connected to continental and marine waters exchange in coastal ecosystem of the Southern Bohai Sea. The monitoring of key parameters could get the chance to understand the interactions between these processes and the evolution of the coastal zones, via analysis of vegetation stress, morphological and land-use changes and events of water quality anomaly (algal bloom, coastal discharge). The remote sensing (RS) data is used for detecting and characterizing such significant ecological and physical parameters. Moreover, efforts to exchange, build on and also develop new methodologies for the retrieval of Earth Observation (EO) products from RS data will be addressed and experts on hydro- bio- geomorphologic processes will benefit the understanding of ecological and morphological EO products and vice-versa.

Coastal zones are very important for human development. The pressure on these systems by agriculture and aquaculture, urbanization and industrialization, the exploitation of mineral resources etc. will continue to increase and the development in coastal areas will tend to concentrate in a narrow strip close to the coastline.

From 1980's, in the coasts of Southern Bohai Sea the local resources and environment have been severely depleted by excessive exploitation of natural resources. The limited supply of freshwater, saltwater contamination, soil salinization, contamination from extensive fish-farming and offshore pollution became major problems. These problems, which had a negative feedback on the development of agriculture and fishery economies, also threatened the health of local communities. For example, effluents from aqua-farms contain a large amount of nutrients (such as nitrogen, phosphorus), which sometimes are discharged into sea without any treatments directly causing offshore pollution and

inducing phytoplankton and macro-algae proliferation. Investigating the algal blooms, pollution and sediment transport, saltwater intrusion, dynamics and causes of coastal erosion and subsidence, is then a priority for the management of coastal hazard and the definition of risk-mitigation measures. It requires multidisciplinary methods of in situ investigation (e.g., geology, geomorphology, geophysics, environmental geology, geochemistry) and RS observations (e.g., water quality, land-use and land-cover, detection of anomalies, coastal mapping).

#### Objectives of the project and state-of-the-art

The specific objectives of EPHEBUS are: a) to identify the effects of seawater contamination on soil and vegetation; b) to detect the effects of land subsidence on coastal morphologies; c) to characterize water quality anomaly events (algal bloom, coastal discharge), also connected to human impacts; d) to integrate multi-source information and multi-temporal data for the interpretation of hydro-geo-morphological processes at regional and local scale. EPHEBUS will focus on two extreme conditions: i) a natural site of the Yellow River Delta (YRD), the YRD Ecological Research Station of Coastal Wetlands, CAS research station, build for interdisciplinary studies and cal/val site, and ii) a coastal area of the Laizhou Bay subjected to intense human activities (Fig.1). Remote sensing has been successfully used in the past, and the results were encouraging, particularly in the ocean color monitoring, land use, dynamic coastline monitoring and beach detecting. Some results of RS data analyses for the study areas are summarized, they will be updated and implemented during the EPHEBUS project.

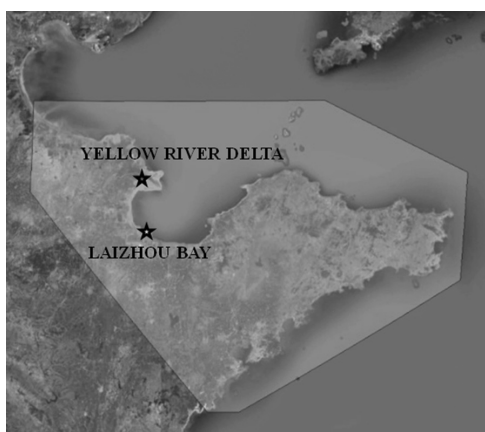


Figure 1 – Test sites of EPHEBUS project: Yellow River Delta and Laizhou Bay.



## Spatial-temporal Dynamics of vegetation coverage, river channel and coastline in the Yellow River Delta and Laizhou Bay

Normalized Difference Vegetation Index (NDVI) is one of the most successful index used to simply and quickly identify vegetated areas and their “health conditions” from multispectral RS data. It was applied to the coastal area of Southern Bohai Sea in order to analyze the space-temporal evolution of vegetation coverage, in the recent 10 years. On the basis of 372 images of SPOT/Vegetation from 1998 to 2008, decreasing NDVI trends dominated the Shandong Peninsula, along the coastline, while increasing trends gradually became more prominent from the coastline to the inner land. Human activity and its spatial distribution were the main causes of NDVI changes: urbanization, industrialization and exploitation of the coastal wetlands resulted in a decay of NDVI (Liu et al., 2010). The increasing NDVI trends dominate the majority of YRD, despite the almost constant NDVI value in the north and northeast (Li et al., 2011). Under the influence of deposition of suspended matter, erosion of coastline and embankment works, the distribution of vegetation varied with time dramatically. After the Yellow River changed its course in 1976, deposition was replaced by erosion in the north and northeast, the distribution of vegetation decreased. However, the suspended matter brought by the Yellow River developed new land in the southeast, which expanded the vegetation distribution. In the late 1980's, artificial levee and jetty were built in the east and northeast, which restrained the erosion significantly, so that the vegetation distribution seldom changed significantly since then. From 1997 to 2004, the boundary of vegetation kept stable in north and east, extended along with the deposition in southeast, as a whole, the vegetation coverage increased (Zhang et al., 2010).

An interesting analysis was made by Wu et al. (2009), in a coastal ecosystem in the YRD. They tested if the elevation gradient interacts with the redistribution of water and soil solutes to determine regional vegetation pattern. According to values of NDVI, the vegetation could be separated into low, medium and high levels. The low level area was high in soil salinity; the medium level lied in the low salt area with meadows; the high NDVI level area was located in high altitude region and the soil is lower in salt, mainly covered by cultivated land, reeds and meadows. The results show highly significant correlations between NDVI of the major plant communities and elevation at all scales, which may closely associate with the groundwater depth at smaller scales and with water redistribution at larger scales.

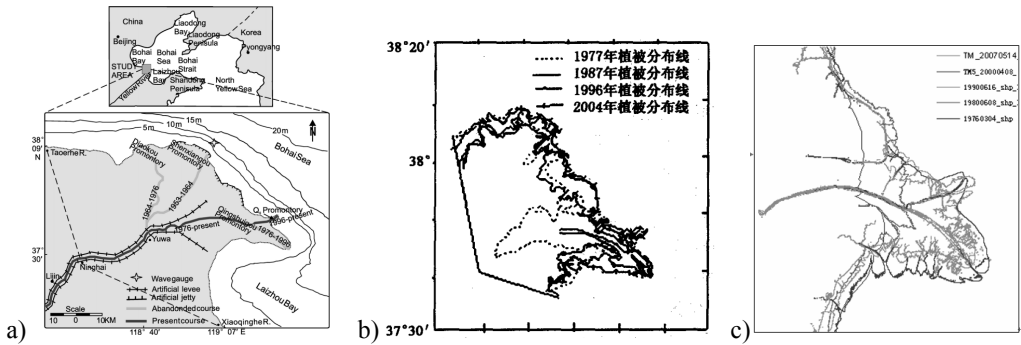


Figure 2 - a) The modern YRD (Chu et al., 2006); b) Change of the vegetation boundary from 1977 to 2004 (Zhang et al, 2010); c) Evolution of coastline at the YRD during the 1976-2007 period.

### Land subsidence of Yellow River Delta

Several studies have been carried out to determine YRD land subsidence (Liu et al., 2001; Bie et al., 2006; Song et al., 2004; Liu et al., 2009). Although there are differences both in spatial-temporal range and analysis methods, we can conclude that the subsidence phenomenon is exactly widespread in the YRD. At present, the main approach to the research on land subsidence of YRD is conventional repetitive leveling measurement but intensive and systemic study of YRD should be developed with interferometry technique. InSAR and PS-InSAR techniques are becoming more and more important in this field of research. Combining with leveling, InSAR has great potential in the further subsidence monitoring of the YRD. Some interesting applications of such techniques were made by Yao et al. (2008) in the YRD and by Liu (2010) in south of Xiao Qing River (fig. 3).

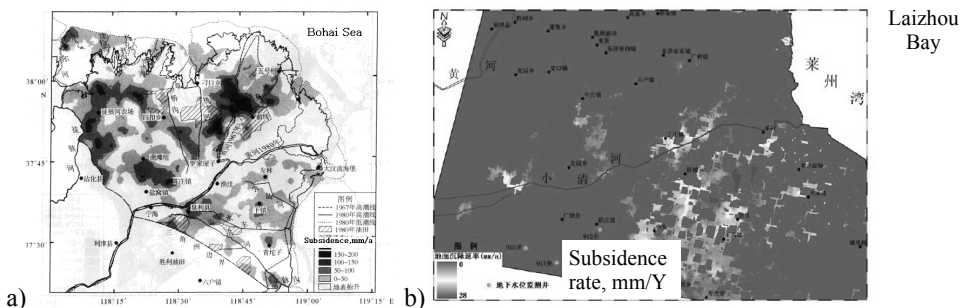


Figure 3 - a) Distribution of vertical surface deformation rate in the YRD from 1956 to 1980 (Bie et al., 2006); b) Monitoring result of the land subsidence in south of Xiao Qing River from 2007 to 2008 by D-InSAR technique (Liu, 2010).

## Materials and methods

Advanced remote sensing techniques integrating optical, thermal and microwave imageries will be applied for identifying changes in land-cover and land-use over the last decades, highlighting the transformations from agricultural to industrial use or from wetlands to fish farms which impacted coastal ecosystems. Moreover, RS data will be used for monitoring water quality parameters and for studying ecological vegetation responses to soil salinization. By combining multi-hyperspectral and Interferometric SAR-based data the feedback in time and spatial scale of the bio-geophysical parameters will be analyzed and integrated with in-situ knowledge and investigations. Analytical methods are here summarized:

- identify the effects of seawater contamination on soil and vegetation. Vegetation could be sensitive to soil salinization, which is a common problem in areas with low precipitation, frequent storm surges and high evaporation. Salt affects plant growth, the early signs of salinity damage and when the problem becomes serious are visible on the spectral response. Optical data, in particular hyperspectral imagery, could provide accurate vegetation stress index maps, which are connected to water and saline soil contents. Many spectral indices will be applied on images acquired by optical sensor and they will be used as an ecological indicator to identify salt water contamination. We will provide those maps at regional and local scale, collecting ground truth data on YRD test site, simultaneously to PROBA-CHRIS acquisitions. Multi temporal analysis will enhance the pre-disturbance and post-disturbance conditions.

- detect the effects of land subsidence on coastal morphologies. In the study area, land subsidence is influenced by natural and human-induced factors and has generated marked environmental changes, particularly with respect to coastal erosion, wetland shrinking and salt water incursion. So, recent ground subsiding value, obtained by Differential SAR Interferometry and Persistent Scatterer Interferometry (PS-InSAR) will be related to the system of morphological evolution, build on high resolution multispectral imagery. The Differential SAR Interferometry and Persistent Scatterer Interferometry techniques are suitable for applications concerning environmental studies, as the monitoring of delta evolution and coastal erosions as well as the analysis of seasonal groundwater variations especially due to human impact. The available large amount of SAR and multispectral data, in conjunction with field information let us to produce deformation maps and time-series from 1990 up today to point out the temporal evolution.

- characterize water quality anomaly events (algal bloom, coastal discharge), also connected to human impacts. EO data, mainly of MERIS of ESA and HY-1B sensors COTCS and CZI of Chinese satellites, will be utilized to monitor quality parameters of southern Bohai Sea. We plan to produce

products regarding the distribution of suspended matter, light attenuation ( $K_d$ ) and algal blooms. In particular, we consider bloom of cyanobacteria, red tides and also macro-algae. Such products could be implemented in a rapid-response remote-sensing based monitoring system to provide timely information on the occurrence and characteristics of water quality anomaly events (location, size and potential trajectory).

- integrate multi-sources information and multi-temporal data for the interpretation of hydro-geo-morphological processes with a special focus on the surficial and groundwater exchanges at regional and local scale. Finally, hydro-geo-morphological processes will be reconstructed by means of interpretation of spatiotemporal, seasonal and interannual changes. It should be possible to provide regionally specific information to government agencies and non-governmental organizations working to mitigate natural and human impact.

Expected results An EO monitoring methodology integrating EO products and surface/subsurface land information and hydrological models to detect the effects of seawater contamination and continental water discharge on the coast.

The RS data will be used for detecting and characterizing significant ecological and physical parameters. An integrated analysis of multi-temporal data from optical and SAR sensors is proposed at regional and local scale.

- ✓ Experts on hydro- bio- geomorphological processes will benefit from the understanding of ecological and morphological EO products and vice-versa.

#### Acknowledgments

This work is part of an ongoing research project, which is developed by the Institute of Marine Sciences (ISMAR) and the Yantai Institute of Coastal Zone Research (YIC) within the framework of the Agreement Research Programme 2011-2013 between the Italian National Research Council and the Chinese Academy of Sciences.

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## **SALT CONTAMINATION PROCESS IN COASTAL AQUIFERS OF YANTAI, CHINA, AND VENICE, ITALY**

Abstract: The knowledge of hydro- morpho- geological processes occurring in lagoons and wetlands all over the world is of paramount importance because of the widely recognized buffering function of these unique transitional ecosystems, for biodiversity and for valuable economical resources as agriculture and fisheries.

We present an overview on the salt contamination process affecting the Laizhou Bay (Southern Bohai Sea, Yantai, China) and the Venice Lagoon (Northern Adriatic Sea, Italy), pointing out similarities and differences. Moreover, we report on preliminary results of multidisciplinary surveys and analyses carried out to test an integrated methodology suitable for a better understanding of the fresh-salt surficial water- groundwater interactions in the two study areas.

Keywords: continental-marine groundwater interaction, saltwater intrusion, hydrogeology, Yantai, Venice.

### **Introduction**

The coastlands of the Southern Bohai Sea, China, and the Northern Adriatic Sea, Italy, are precarious environments subject to both natural changes and anthropogenic pressure. Climate changes and stresses induced by human activities, e.g. pollution, engineering interventions for dams, flood control, canalization, urbanization, agriculture and fish farm activities are the main causes of increasing degradation and loss of habitat.

Over the past two decades, seawater intrusion has become a serious environmental management issue. The Laizhou Bay (Yantai) (Fig. 1a) is one of the areas more seriously impacted by saltwater contamination in China, which derives from modern seawater intrusion and fossil brines and salines located in shallow Quaternary sediments. Two major problems are related to the groundwater

contamination by salt: a) effects on the human health (e.g., bone fluorosis, macular teeth) due to fluorine excess in drinkable water, and b) the reduction of agricultural productivity due to soil salinization.

The Laizhou coastland can be divided in four areas on the basis of the salt components in the groundwater (e.g., Meng et al., 2002). The area to the north of Laizhou City is affected by recent seawater contamination, the nearby Baisha River-Jiaolai River mouth plain area and the Weihe River mouth plain area on the northern Changyi county coast are characterized by mixed seawater and fossil saline groundwater intrusion. The contamination of fossil brine prevails in the northern Shouguang plains Recently Han et al. (2011) provided a conceptual model of the relationships between the various water types and their related processes in a spatial context. A hydro geologic sketch for the southern Laizhou Bay is shown in Fig. 1b.

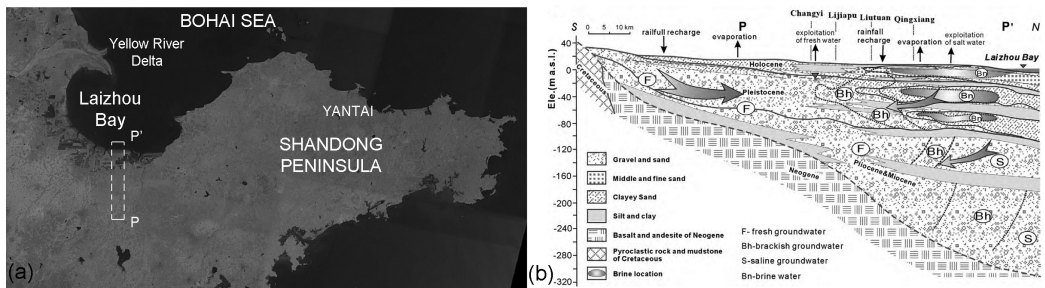


Figure 1. (a) Satellite image of the Southern Bohai Sea and Shandong Peninsula. (b) Hydrogeologic conceptual model along the cross-section P-P' (modified from Hang et al., 2011) which location is shown in (a).

In the coastland surrounding the Venice Lagoon (Fig. 2a), the combined effect of sea level rise, land subsidence, and reclamation activities has enhanced saltwater contamination and the related soil salinization with serious environmental and socio-economic effects. The risk of soil desertification and the decline of agricultural activities are major problems in the coastal farmlands.

In the catchment located south of the Venice Lagoon, a serious aquifer contamination due to saltwater intrusion from the sea and the lagoon is inducing a high soil salinization which severely affects crops productivity. The saltwater extends inshore up to 20 km far from the Adriatic Sea coastline and the saltwater plume is observed from the near ground surface down to a depth of 100 m (Fig. 2b).

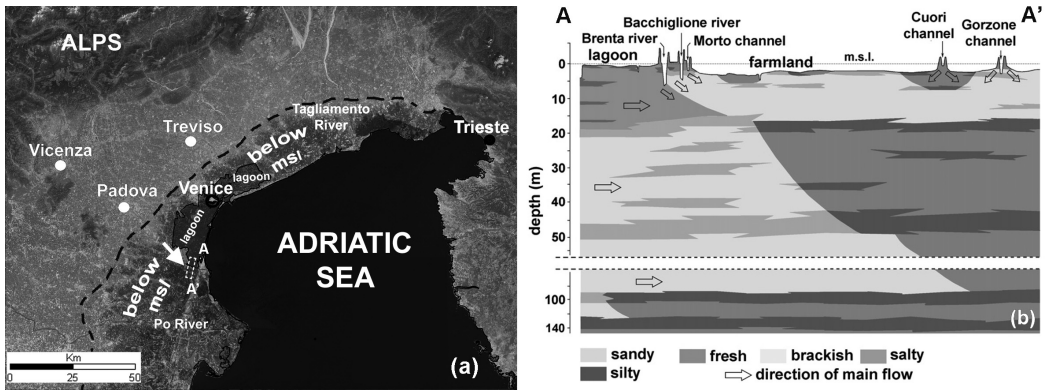


Figure 2 – (a) Satellite image of the northern Adriatic Sea. Black dotted line shows the bounds of low-lying areas. (b) Hydrogeologic conceptual model along the cross-section A-A' at the lagoon margin. The trace of the section is highlighted by the white arrow in (a) (modified from de Franco et al., 2009).

Geological studies pointed out that geomorphologic features and stratigraphic setting can favour or mitigate this process. In particular, well developed paleo-river systems and permeable sediments represent preferential pathways for the communication between waterbodies characterized by different salinity, whereas thick silt-clayey layers can preclude the saltwater/saline contamination from the lagoon and the sea. Changes in river discharge, regulation of phreatic water levels by means of pumping stations, climatic conditions, fresh-water input for irrigation purposes, and riverbed seepage are important factors that affect positively or negatively the saltwater contamination (de Franco et al., 2009). Saltwater is released from the bed of the watercourses into the surrounding farmland when seawater encroaches the river estuary and upstream reaches in dry periods. This process is influenced by the tidal excursion and the river regime. The ground elevation of the territory, generally below the mean sea level up to -4 m, enhances the salt contamination process especially in those sectors where land subsidence, mainly due to the oxidation of peat soils in connection with the agricultural practices, is responsible for a subsidence rate varying between 1.5 and 2 cm/yr.

In both study areas, the occurrence of buried geomorphologic features and land use changes play an important role in salt contamination of groundwater and soil. The presence of sandy paleo-channels enhance the saline groundwater flow landward while land reclamation changes the surface-groundwater exchanges. To better understand this issue, it is crucial to investigate these aspects inland and within the sea/lagoon, wetland/delta, covering both its permanently wet areas as well as the tidal flats.



An integrated monitoring approach for understanding the relationships between continental and marine waters

The Yantai-Laizhou coastland and the Venice Lagoon can be considered two relevant “laboratories” where geophysical, hydrological, and hydrogeological surveys, remote sensing, and geochemical analyses can be tested in various environmental conditions.

### Remote Sensing

Optical and thermal infrared data have been collected for the coastal zone of Laizhou Bay to identify morphological and land use changes at “regional” scale, together with water discharges related to different coastal land-use. Mainly Landsat MSS, TM and ETM+, MODIS-Terra, SPOT-VGT scenes have been acquired. Fig. 3 shows two satellite images acquired in 1979 and 2010, from Landsat-MSS and Landsat5-TM, respectively. The image comparison highlights the main morphologic and hydrologic changes occurred over the last three decades.

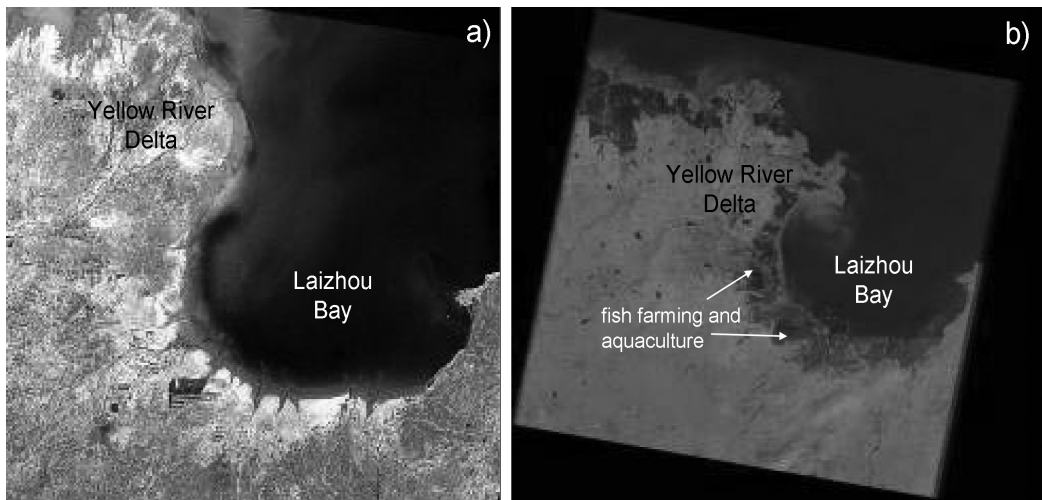


Figure 3 – Satellite images of Southern Bohai Sea. a) 1979 Landsat-MSS, b) 2010 Landsat5-TM.

### Hydrochemical investigation

A total of 32 wells, from 5 to 40 m deep, located within 10 km from the coastline, have been selected for long-term groundwater level observations and water sampling. Preliminary investigations

on the saltwater intrusion process have been carried out in the eastern Laizhou Bay by Wen et al. (2012). They demonstrated that the three main hydrochemical processes controlling groundwater chemistry is determined by: i) seawater intrusion, ii) chemical weathering water–soil/rock interaction, and iii) nitrate contamination. Preliminary investigation pointed out that the hydrochemical methods are useful tools for interpreting complex water quality data and the origin of groundwater salinity. The obtained information represents a benchmark/basis for future hydrochemical investigations that will be useful for the groundwater management in the study area (Fig. 4).

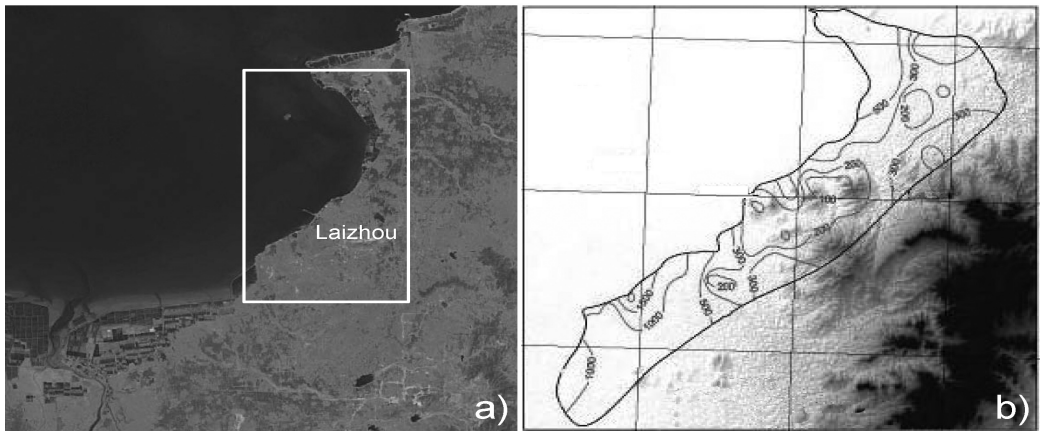


Figure 4 – a) Satellite image of the eastern Laizhou Bay. b) Iso-Cl<sup>-</sup>(mg/l) contour map (modified from Wen et al., 2012).

### Geophysical surveys

The field activity performed in the Venice case study was focused on the characterization of groundwater and the detection of buried morphological features, such as highly-permeable sandy paleo-channels (Fig. 5a), that can enhance the groundwater flow from the mainland to the sea and/or viceversa. The main goal was the set up of a survey methodology capable to provide both the subsoil architecture and the hydrogeologic setting in very shallow water (about 1 m depth). Very High Resolution Seismic (VHRS) and Continuous Electrical Tomography (CERT) surveys have been carried out and the combined analysis of the two data sets highlighted a correlation between lithostratigraphic discontinuities and heterogeneity in the fluids saturating the deposits (Fig. 5b).

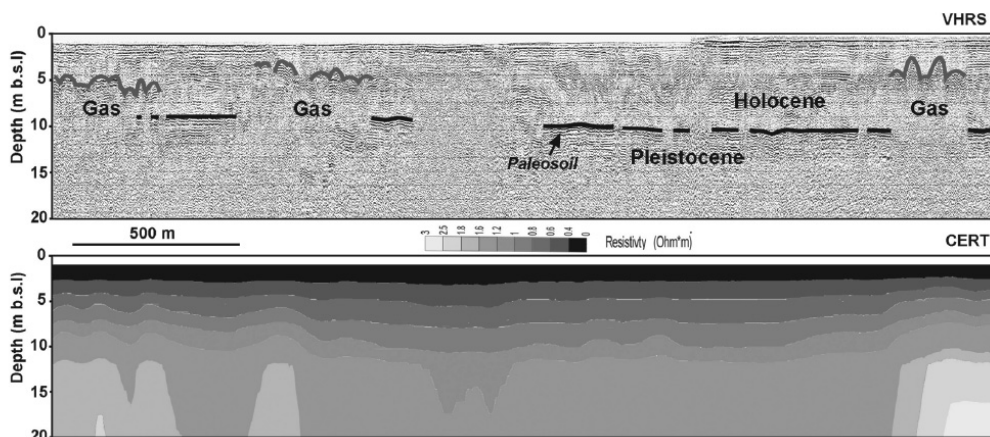


Figure 5 – (a) Example of paleo-channel occurrence in the Venice Lagoon. (b) Preliminary result of the VHSR-CERT test (modified from Tosi et al., 2011).

#### Conclusive remarks

The investigation performed in the coastal region of the two test areas, Yantai and Venice revealed that a comprehensive quantification/description of surface water–groundwater exchanges in coastlands is still a challenge. The contamination process is due to complex inter-relationships between ground-, surface-, and lagoon-waters combined with the significant heterogeneity of the sediment deposits and soils. In particular, both areas experience a significant saltwater intrusion in the upper aquifer systems as a result of natural processes and human activities. Such occurrence, which is relatively recent, reduces the availability of freshwater resources, the soil productivity, and increases the risk of soil desertification. Just below the upper unit, paleo-brines are generally found in the Laizhou Bay. Conversely, a 200-400 m freshwater multiaquifer system is well developed in the Venice coastland, and brackish paleo-waters are located only below 300-500 m. If brines represent a strong limitation for the development of the Chinese site, with negative effect also on human health because of the high-fluorine content, deep brackish aquifers at present do not negatively affect the Venice coastland because of the freshwater availability in the upper multi-aquifer system and the river network. To increase freshwater availability in northern regions, a project for the derivation of surface water from catchments located at south has been developed by Chinese authorities.

## Acknowledgments

This work is part of an ongoing research project, which is developed by the Institute of Marine Sciences (ISMAR) and the Yantai Institute of Coastal Zone Research (YIC) within the framework of the Agreement Research Programme 2011-2013 between the Italian National Research Council and the Chinese Academy of Sciences.

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## **ENVIRONMENTAL PROTECTION AND ECONOMIC DEVELOPMENT**

The huge territorial-economic-demographic dimensions of China would be an exemplary field in order to study the global issues of sustainable development and the the future of our world. Because China has to face the most extraordinary problems of the world , more than all other countries, studying their solutions would provide suggestions for our country and we will help it with our proposals.

China should balance habited and lands, fertile and arid soils, to face climate change, pollution, spreading urbanisation, strong differences of urbanisation between coasts and inland, impacts on coastal zones. Furthermore it seems necessary to manage greater revenue, new wellness and new leisure exigences.

The natural and antropic evolution of Italy and China territories share a long term historical record, since the two countries where cradle for highly-civilized populations, that produced documental material during the last two millennia, at least.

They also share the presence in their territories of intensively industrialized and populated areas along the major rivers , the deltaic zones and the coastal zones.

These deltaic apparatus and the adjacent coastal areas are characterized by a geomorphological trend controlled by natural (climate and environment) and antropic (deforestation and industrialization) changes.

The increasing urbanisation of coastal cities leads to the modification of anemological patterns of the local circulation because of the formation of the urban heat island.

This phenomenon is mainly produced by alteration of the land coverage usage in terms of both optical and conductive properties of new materials deployed ( buildings, flooring , etc.) and by production of heat generated by anthropogenic activities.

The increased energetic of the planetary boundary layer over the urban canopy can strongly alter the local winds and, consequently, the precipitative patterns as well as the recirculation

of pollutants and their deposition pathways causing impacts on the human health and marine environment.

The rate of these changes has not been constant during the last millennia, being mainly controlled by anthropogenic variables at regional and global scales.

We propose to compare and to define, in the selected Chinese and Italian coastal zones, the effect of the global and regional changes in the past times. On the basis of these studies we can understand the future evolutionary trend of the selected areas.

Our work will focus the comparison of the Italian plain industrialization history, which date back to the beginning of the last century, and the effects of the newly booming Chinese economy which is in a huge expanding phase.

We will also compare those recent changes to that occurred in the past, i.e., the beginning of intensive agriculture and farming, the alternating periods of wet and dry climate which induced important changes in the characteristics and rate of sediment supply in both natural systems.

We also propose to recover and organize already collected geological, geophysical and environmental data in key selected location in Chinese and Italian coastal zones. A particular attention to the collection, elaboration and comparison of the geomorphological and cartographic data of the studied areas.

The study of the variations of the bathymetry in shallow water to understand when the situation evolves to a dangerous state for the coastal equilibrium. The comparison of these data with the bathymetric data of the past times provides indications about the evolutionary trend of the studied areas.

The study of the superficial sediment distribution, with special attention to grain size parameters to provide sediments maps following both the Shepard and Nota classifications to evidence the variations of the energetic level in the coastal zone.

The goal of the project is to give significantly contribute to enhancement of management plans of protected areas from floodplains, wetlands and coastal areas, by comprehensive consideration of geological diversity.

Benefiting from the high Italian experience, a geotourism strategy will be promoted in order to ensure long term development of the protected area through sustainable and quality tourism and to attenuate disparities between protected areas from the Italian and the Chinese seas.

Finally: researches from a comparative point of view of the national and the local legislations on environmental protection. Comparison between Italy and China with regard to the rules for the environmental protection.

All the results of the studied chinese and italian selected areas will be used to try to answer to the following questions:

- 1) are there differences in the geomorphological and sedimentological records of corresponding sectors of the selected natural systems at different times scale from the past times up to the present time?
- 2) Are these differences mainly controlled by local factors, such a different industrialization history, or by global forcing (global changes)?
- 3) What is the environmental present-day status of these delicate environments under different anthropogenic pressures?
- 4) At the light of the italian experience , could we forecast the effect of intensive use of the territory under similar conditions in the present day China for the next future?
- 5) Could we offer some warnings?

This is only a first attempt to face the same economical and environmental problems interesting the italian and chinese coastal zones.

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## **EVENTI STORICI COME INDICATORI DI VARIAZIONI CLIMATICHE IN EUROPA E IN CINA**

È noto che il clima ha subito notevoli variazioni nel corso dei tempi geologici. Per tanto riguarda il Quaternario, gli ultimi due milioni di anni, si sono susseguiti periodi glaciali intervallati da periodi interglaciali. Il periodo attuale, l'Olocene, fa parte di un interglaciale che si protrae da circa diecimila anni. Pur nell'ambito di un generale miglioramento climatico, rispetto all'ultimo periodo glaciale, si sono manifestate nell'Olocene importanti variazioni climatiche che hanno avuto grande influenza sia sugli ambienti fisici, sia sugli ambienti biologici.

Sulla base di indagini geologiche, geomorfologiche, glaciologiche, paleobotaniche, archeologiche e storiche, è stato possibile ricostruire il susseguirsi delle oscillazioni del clima con una certa precisione, specialmente per i tempi storici. Per i tempi più recenti, poi, quando hanno avuto inizio e sono andate sempre più diffondendosi le registrazioni meteorologiche, le fluttuazioni del clima sono state meglio riconosciute e dettagliate.

Le valutazioni delle fluttuazioni climatiche per i tempi storici precedenti le registrazioni strumentali si basano su dati di natura parameteorologica, quali le descrizioni relative ad eventi meteorologici e idrologici estremi, oppure all'andamento delle fonti glaciali, alle modificazioni delle fasce vegetazionali naturali, al regime dei corsi d'acqua, dei laghi e delle paludi, all'andamento dei raccolti, alla comparsa o scomparsa di particolari specie di animali o piante e alle caratteristiche degli anelli di accrescimento dei tronchi degli alberi o dendrocronologia.

Gli studi e le ricerche di questo ultimo decennio hanno messo in evidenza che nell'ambito del generale miglioramento climatico, rispetto al passato, dall'Olocene, si sono manifestate più modeste fluttuazioni climatiche, sia in senso freddo-umido sia in senso caldo-secco. Il fenomeno sembra manifestarsi con cicli sia dell'ordine delle centinaia, sia dell'ordine delle decine di anni, che però ad intervalli tendono tra loro a sovrapporsi ampliandone gli effetti.

Per quanto riguarda gli ultimi 4.000 anni è possibile trovare validi riscontri storici per tutto l'emisfero settentrionale delle fluttuazioni climatiche evidenziate in special modo dalle curve dendrocronologiche.



Per il presente e il futuro, l'importanza delle fluttuazioni climatiche e conseguente applicazione pratica negli interventi a difesa degli ambienti naturali è evidente. Se infatti è possibile prevedere il verificarsi di eventi meteorologici destabilizzanti, quali mareggiate sulla fascia costiera o piene rovinose dei fiumi, diventa possibile svolgere un'efficace azione preventiva. Per poter verificare la validità e quantificare la frequenza delle fluttuazioni climatiche, è necessario rivolgere le indagini al passato. In questo caso i riscontri storici sono importanti, ma da soli non sono sufficienti a garantire un risultato certo, in quanto le azioni dell'uomo potrebbero essere state motivate anche da altre cause indipendenti dalle variazioni climatiche. Per questa ragione è indispensabile abbinare ai dati storici altri dati, indipendenti dall'azione antropica, come ad esempio le curve dendrocronologiche. Per meglio evidenziare questo concetto si portano alcuni esempi.

La Fig. 1 mostra una curva dendrocronologica riferita ai Monti White in California. Su di essa sono riportati periodi storici riferiti all'Europa.

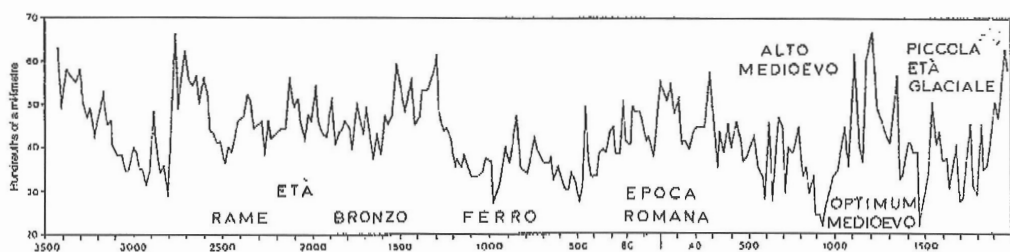


Fig. 1 – Curva dendrocronologica dei Monti White in California (Lamb, 1982; Veggiani, 1994).

Trarre i riscontri storici con le variazioni climatiche è relativamente semplice, trattandosi di operare su larga scala su fluttuazioni climatiche dell'ordine di migliaia di anni. Risultano infatti evidenti i periodi freddo-umidi della fine del Neolitico, dell'età del ferro, dell'alto Medioevo e della piccola età glaciale intervallati agli *optimum* climatici dell'età del bronzo, dell'epoca romana e del Medioevo. La coincidenza dei medesimi eventi climatici in zone diverse mostra la validità del fenomeno su una larga fascia dell'intero emisfero settentrionale.

Le cose divengono più complesse quando si opera su scala temporale più breve.

La Fig. 2 mostra il canale artificiale che unisce Pechino al Sud della Cina intersecando i maggiori fiumi che si sviluppano tutti da W a E.

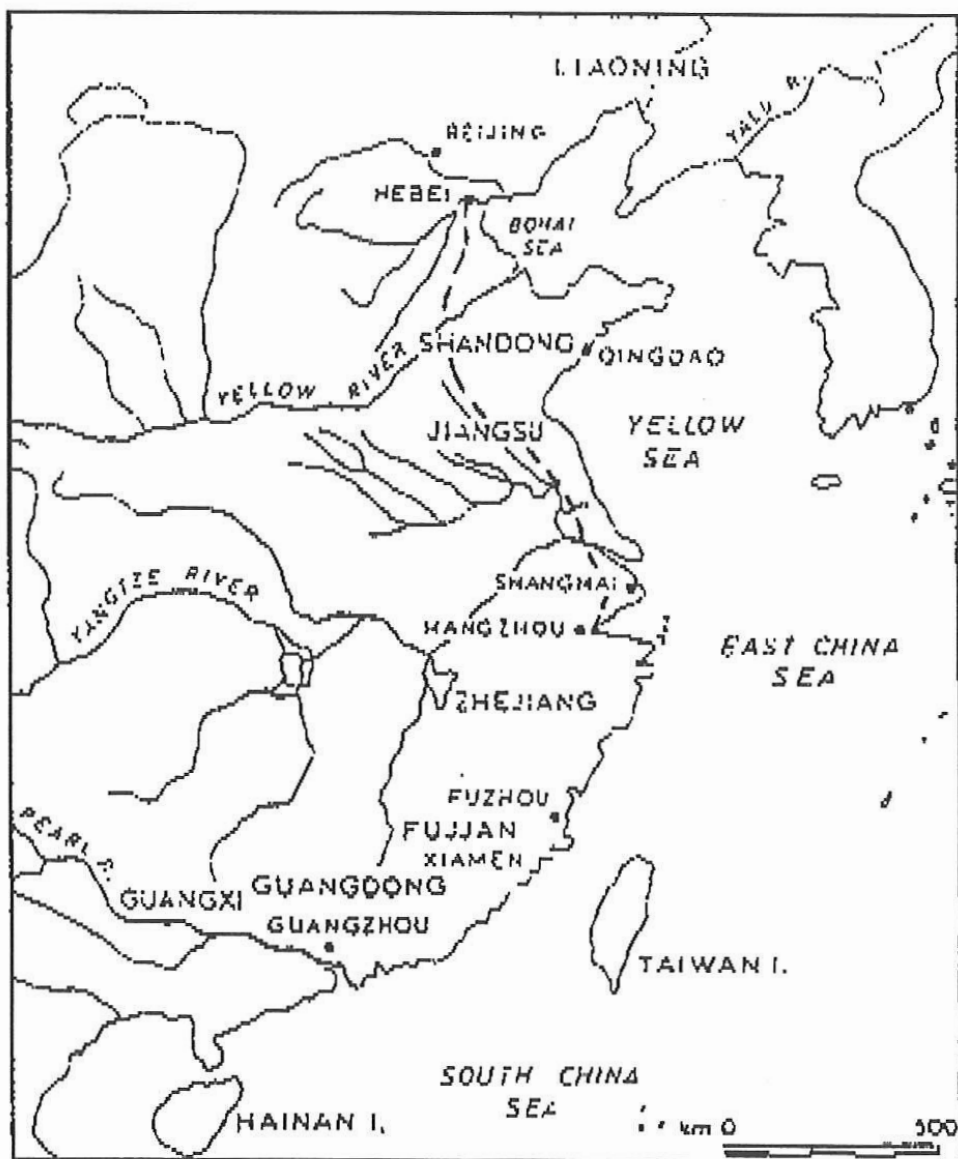


Fig. 2. Tracciato del canale navigabile tra Pechino e Hangzou.

In questo caso il riscontro storico con le variazioni climatiche è problematico in quanto il canale è stato costruito dal 219 a.C. al 1273 d.C. durante periodi di variazioni climatiche fredde e calde, quindi più che cause climatiche che ostacolavano la navigazione costiera con aumento di burrasche,

sembra più ovvio il semplice calcolo economico di trovare vie di comunicazioni più convenienti e più dentro il territorio.

In Fig. 3 è riportato il confronto tra la piovosità in Cina in epoca storica e il traffico carovaniero lungo la via della seta; in questo caso si trova una corrispondenza tra diminuzione del traffico e minor piovosità. Ma senza la curva della piovosità il solo dato storico poteva essere dovuto a cause estranee al clima quali conflitti locali o aumento del brigantaggio o più semplicemente scelta di altre vie di comunicazione più convenienti economicamente.

Per interpretare correttamente la corrispondenza tra variazioni climatiche e relativi riscontri storici, anche nell'ambito di una stessa fascia di latitudine, l'esempio della via della seta (Fig. 4) ci permette di osservare come gli effetti sull'attività antropica possono a volte differenziarsi anche durante la stessa fase climatica, Infatti le fasi fredde e piovose costituivano periodi positivi nell'ambiente desertico dalla Mongolia all'Arabia, e contemporaneamente costituivano periodi negativi nell'ambiente temperato europeo per l'aumento di gelate dannose all'agricoltura, piene rovinose dei fiumi con conseguenti aumenti di franosità in montagna e straripamenti in pianura.

Da questa breve nota risulta l'importanza delle fluttuazioni climatiche nella salvaguardia degli ambienti naturali mediante un'azione preventiva finora mai effettuata e d'altra parte i possibili riscontri storici permettono, oltre a confermare la frequenza delle fluttuazioni climatiche, anche di comprendere su scala non più locale, ma per vaste fasce di latitudine, le cause che hanno determinato l'azione dell'uomo nel passato.

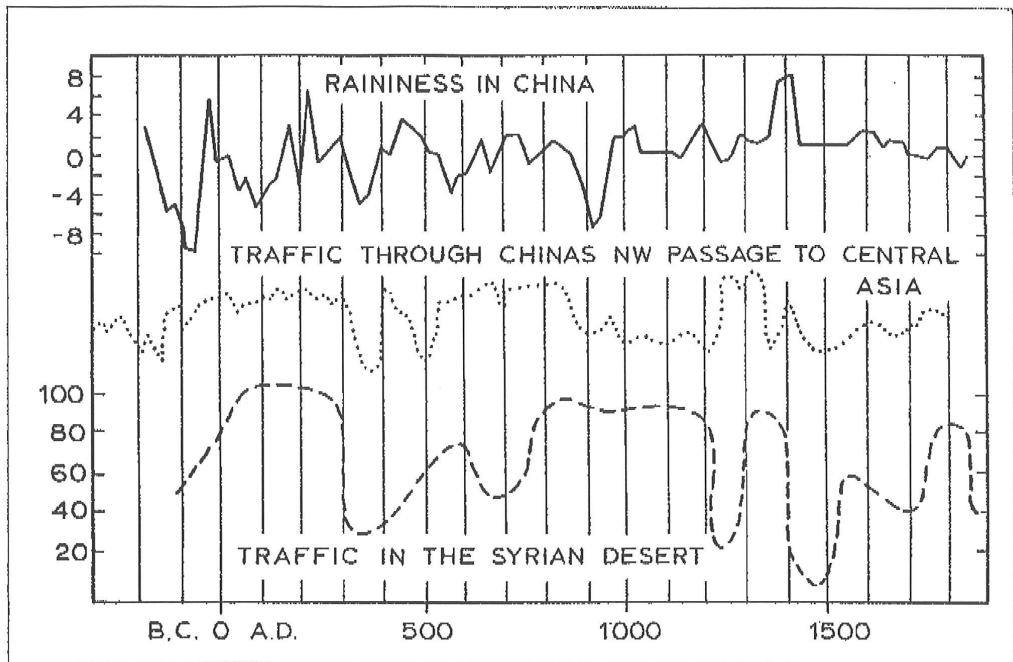


Fig. 3. Curva della piovosità in Cina e intensità del traffico carovaniero lungo la via della seta (Lamb, 1982).

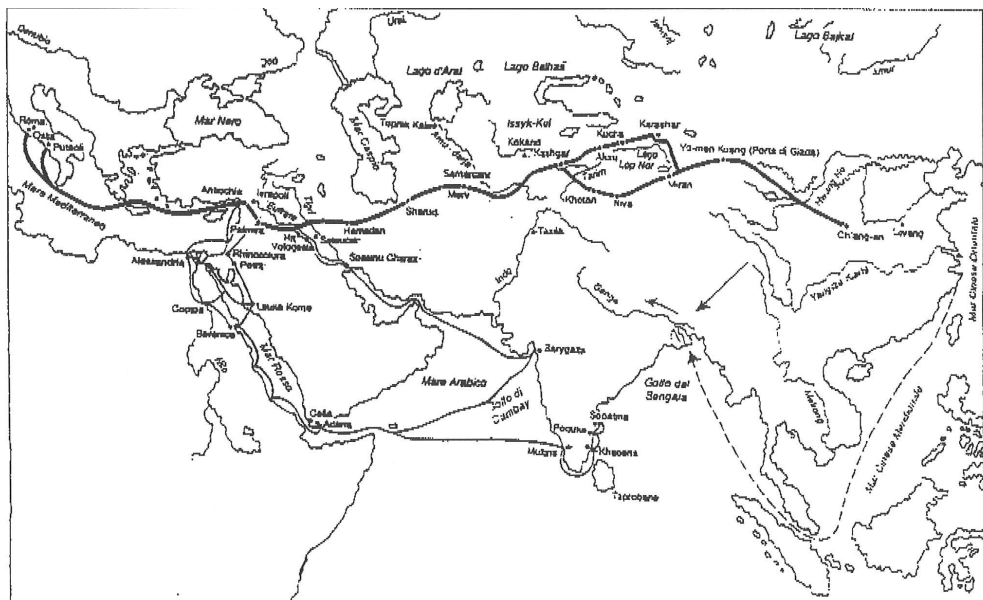


Fig. 4. La via della seta dalla Cina al Mediterraneo.

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## ALLEGATO

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### **PURSUING HIGHER EDUCATION TEACHING AND LEARNING EXCELLENCE: THE CASE OF TAIWAN**

#### Preface

With the expansion of higher education in the 1990s, universities in Taiwan have been facing challenges in working with a far more diverse student population than before. In order to ensure the quality of higher education, the Ministry of Education in Taiwan has initiated a series of programs since the late 1990s. Started in 2005, the Ministry initialized the new scheme '*Program for Encouraging Teaching Excellence*' with the aim of promoting good teaching practices and developing model examples of teaching excellence. From 2005 to 2012, the total funding 386 million US Dollars are spent on funding around one third of universities annually to promote teaching excellence.

The paper traces the development of the teaching and learning policies in Taiwan and analyses the teaching and learning approaches of the thirteen universities which took part in the first round of the scheme '*Program for Encouraging Teaching Excellence in Universities*'. It aims to explore how teaching and learning excellences are carried out and put into context in Taiwan. In so doing, it is hoped that some critical reflections about teaching excellence can be formed.

The context – the expansion and the diversification of student needs

After WW II, higher education in many countries have experienced huge expansion. Martin Trow (1973) studied the development of higher education in Europe and USA and divided them into three stages: elite, mass and universal which was based on the enrollment rate of the age group. For those HEI with an enrollment rate below 15% is considered as elite type, those between 15-50% are deemed as mass type, and those with an enrollment rate over 50% are considered as universal type. According to the latest statistics, Taiwan has reached the final stage. Since 1990s, higher education in Taiwan has been experiencing great expansion. Together with the low birthrates, the entry into

WTO and impact of market force, higher education institutions is given more autonomy, but also under more pressure to keep up to the international competition. In the 21<sup>st</sup> century, higher education is facing an even greater challenge. Tai (2006) argued that most countries place great importance in promoting academic excellence due to:

1. knowledge and globalization have changed the form of international competition. Knowledge has become the base for the success of economy. Thus, universities are surely playing a key role in knowledge creation;
2. due to diversification of higher education, traditional elite universities can no longer meet the needs of the society;
3. massification of higher education further dilutes resource, thus limited resources can only be distributed to certain universities with the reputation of excellence;
4. due to the competition in attracting international students, pursuing academic excellence has become the best strategies for universities.

Thus, Western countries such as the US, Canada, the UK, Australia and New Zealand, as well as many European countries are increasingly assessing institutional goals, processes and outcomes of higher education institutions. Universities in return have often established mechanisms to evaluate and to reward teaching quality and to establish centers to improve teaching. (David Watkins, 1998) The paper intends to examine the related quality assurance mechanism and strategies in promoting teaching excellence in Taiwan. In doing so, it is hoped that some critical reflections about the current policies can be formed.

The great expansion of higher education institutions

Higher education institutions (HEIs) in Taiwan have gone through rapid expansion since late 1990s (Table 1). In 2005, the number of HEIs has risen to 162. There are now more private institutions than public ones. The private institutions admit more students than the public ones. It is also important to indicate that many colleges and universities are having more and more difficulty in recruiting enough students as the birth rate has dropped rapidly in Taiwan. Therefore, HEIs which can not perform well enough to attract a significant number of students face a great challenge.

Table 1 Numbers of Colleges and Universities in Taiwan since 1966

Year	Total
1966	21
1971	23
1981	27
1991	50
2001	135
2012	163

(Department of Statistics, Ministry of Education, 2012)

The massification of higher education also bring great financial burden to national governments. In order to maintain the quality of higher education as well as release the financial burden, the relationship between national governments and higher education is also changing. Overall, most governments have shifted their role from control to supervision, as well as introducing the market force and encourage competition in order to improve the efficiency in management (Tai, 2002).

In Taiwan, universities are also required to find their own financial resources as a result of limited funds. While the private sector is used to finding resources on its own, public institutions are having difficulty to adjust to the new setting. Moreover, increasingly more and more colleges and universities have difficulties in recruiting students owing to the rapid decline of birthrate and the over supply of higher education learning opportunities.

The emphasis of international competitiveness

Besides the domestic competition for resources, with the entry into WTO, there is a need for HEIs to compete internationally. Thus, education has become an importance instrument for maintaining national competitiveness in the global economy. As a result, the Vice-Minister of Education Lu, Mu-lin made the following announcement in 2003:

“The Ministry would like at least one of its universities to be ranked among the top 100 leading international institutions of higher education, within the next ten years and to have at least one university ranked as number one, within Asia by the next five years”. (Lu, 2003)

For this reason, there have been efforts by the Ministry of Education(MOE) to move toward the diversification of higher education institutions. Thus, the MOE has adopted a policy of differentiation, by which universities would be classified into four types: research, teaching, professional and



community institutions. International indicators, such as SCI, SSCI and EI, have been introduced in universities' evaluation systems in order to gain international recognition (Lu, 2003). Not surprisingly, the limited resources can only be distributed to certain elite universities so that they can compete with universities abroad. As a consequence, universities in Taiwan today are under tremendous pressure to perform.

#### The need to promote teaching

As it has mentioned above, the increasing number of universities leads to lower average student quality. Growth in funding for higher education also lags behind the growing number of students, which results in dilution of resources. The insufficient educational resources lead to lowered teaching quality. The limited resources has gravely impacted the quality of education. Furthermore, the tendency for universities to pay more attention to research than teaching has worsened the situation.

Since the 1990s, the MOE has prepared competitive award funding with its '*Academic Excellent Development Project*', '*Plan to Consolidate Research-based Universities*', and '*Plan to Develop First-class Universities and Top-level Research Centers*', with the objective of raising the level of university research. Although both teaching and research are the key functions of universities, it is often criticized that the most of the MOE's funding programs and evaluation indicators pay more attention to raising research level and less attention to raising education quality. As a consequence, universities/colleges tend to pay more attention to research and less to teaching. Many have argued that since higher education has changed from elite education to popular education, more attention should be paid to teaching.

Furthermore, industry and society are increasingly become more and more dissatisfied with new university graduates. Many complain that basic academic knowledge and professional abilities of students fail to reach satisfactory levels and are unable to satisfy the demands of industry and society. With the advent of the knowledge economy, the training of high-level individuals has become the key factor of national development. Without doubt, the role of the university/colleges is significant in terms of producing satisfying workforce. By improving the quality of university teaching, the above objects can be achieved. (MOE, 2006a)

Thus, in 2005, the MOE started to provide competitive funding to encourage teaching excellence and urge universities to continue the improvement of teaching. Since universities possess multiple functions, the importance of teaching should be emphasized.

## Approaches Taken to Promote Teaching Excellence

The approaches that the government has taken to promote teaching excellence are: promoting teaching through evaluation and increasing funding as incentives:

### Promote teaching excellence through evaluation

In order to assure quality of the rising number of higher education institutions, coupled with the intention to compete globally, the government has therefore launched the quality assurance movement in promoting excellence in higher education. The rise of quality assurance movement started in 80s in the Western countries. According to Van Vught (1989), a change has taken places between European governments and the other parts of their higher education systems from 'government control' to 'government supervision'. These changes fit well with the philosophy such as smaller governments, autonomy and deregulation of the time. In the 90s, this kind of ideology found its way into Taiwan.

Although HEIs in Taiwan have been assessed often every now and then, a well-functioned evaluation mechanism is necessary. Therefore, the Ministry has been trying to develop an evaluation mechanism with quality and quantity measures. The central purpose to build an evaluation system, whether internal to a university or external to it via some agencies, is usually related to quality assurance or accountability.

General speaking, there are two models of higher education evaluation for the purpose of the quality assurance and improvement. One is the British model, 'a systematic effort to control degree program content and grading practices through cross-institutional external reviewers.' It is also known as the quality assurance approach. The other is the American model, known as 'institutional and specialized model program accreditation' (Kells, 2006). It allows HEIs voluntarily participate in the evaluation. In the case of Taiwan, the Ministry has been trying to combine the above two models (HEEACT, 2006).

After the amendment of University Law in 1994, the Ministry was given the legal right to be in charge of the evaluation of HEIs. The Ministry set up the Council of Academic Review and Evaluation, entrust academic organizations or professional evaluators to carry out regular evaluation and publish the results as reference for educational subsidies from the government and the scale of adjustment and development of universities. In 2005, the government has further amended Article 5 of the University Law which requires universities to periodically conduct self evaluations on

teaching, research, service, counseling, administration, and student participations. Regulations for the evaluation shall be formulated by the universities.

The evaluation moved to another stage in 2005. Given that resources for higher education are limited, the pressure of competitiveness and that birthrates are falling, it is inevitable that some HEIs will eventually fail. With the revisions of University Law and Private Institute Law in 2005, the Ministry started to establish exit mechanism which is integrated into the evaluation mechanism.

In 2006, an unprecedented scale of program-based evaluation has started. For this reason, the Higher Education Evaluation and Accreditation Council of Taiwan (HEEACT) was established in December 2005. Commissioned by the Ministry, its first task is to conduct a nation-wide university program evaluation, and to set the groundwork for promoting ranking of research performance.

Beginning in 2006 and with every five years as one cycle, HEEACT starts to conduct evaluation on 78 comprehensive universities and their more than 2,000 programs. In 2006, 17 universities of education, fine arts, and physical education, and on a total of 370 programs had been evaluated. Currently, each of the 17 institutions is at the self-evaluation stage. In October, onsite reviews were conducted, and the results of the evaluation will be made public in May 2007.

This is the first time that a nation-wide evaluation is being conducted on all the academic programs in universities and colleges in Taiwan. In particular, HEEACT specifically indicates that the focus of the evaluation is teaching (HEEACT, 2006). For those HEIs that do not pass the evaluation for two consecutive years, the Ministry will enforce the exit mechanism and ask that program to terminate enrollment and cease to operate. The main criteria for the evaluation are: (1), aim, features and self-improvement; (2), curricula design and teaching; (3), learning and student affair; (4), research and professional performance; the performance of graduates.

Promote teaching excellence through funding: moving away from the sole focus of research

Developed countries such as the United Kingdom, America, Japan and Germany have been allocating special funds for the development of higher education. Borrowing from their experience, the Ministry of Education in Taiwan has applied the same approach.

In order to improve the quality of university standards, a five-year '*Academic Excellent Development Project*' was launched in 1999. In the first phase, a total amount of NT\$ 4.3 billion was allocated to fund 19 projects and three of which were offered conditionally. The second round of

the Program was launched and had been implemented from 2002 to 2006. Twelve projects had been funded with a total amount of NT\$ 2.1 billion. It is noticed that most of the funding was received by public institutions. Only two research projects jointly submitted by public and private institutions were funded (MOE, 2003a).

Started in 2005, 'Program for *Developing of First-class Universities and Top Research Centres*' was launched. The Ministry hopes to nurture and cultivate the academic talents of Taiwan and to established ten distinguished and outstanding research centers within Asia, in five years and to have at least one university ranked as one of the top 100 universities globally, within the next ten years. For this purpose, 50 billion NT dollars is to be distributed over a five-year period. In November 2005, after fierce competition, 12 (research) universities were selected and they would continue to receive funding for the following 4 years. These universities must complete a five-stage process ranging over a period of five years, in order to receive maximum funding. However, the project is controversial as many universities have protested against distributing huge amount of grant to few institutions. Many have argued that the fund should be distributed to departments at the program level rather than at the institutional level.

Due to the pressure that only a limited number of universities have received the above funding and also most higher education evaluations tended to have strong emphasis on research performance rather than on teaching, the Ministry initialized another new scheme '*Program for Encouraging Teaching Excellence*' in 2005. Through strict review process, 1 billion NT Dollars was awarded to 13 universities with the aim of promoting good teaching practices and develop model examples of teaching excellence. Again in 2006, after fierce competition, the funding is expanded to 5 billions NT Dollars and is distributed to 28 HEIs and 30 technology HEIs.

The Ministry expects that the above two funding mechanism will help to establish the HEIs classification that it has always desired for. However, in fact of research supremacy, it is uncertain whether the value of institutional diversity can be comprehended and appreciated by universities and the public at large.

National Level: Initiatives in promoting teaching excellence

Program for Encouraging Teaching Excellence in Universities

To raise the quality of higher education and make suggestions on the direction of higher education, the Ministry of Education established a cabinet-level Higher Education Macroscopic Planning Committee in 2002. The committee made the following recommendation: (MOE, 2006a)

- ✓ The government should begin categorizing universities as soon as possible. Universities should be categorized into teaching, research, professional, and community universities. Government funding should be appropriated according to the various categories of higher education in order to encourage universities to diversify.
- ✓ Providing competitive funding to encourage teaching excellence in order to urge universities to continue pursuing improvement on teaching. Universities possess several functions including teaching, research, and service. Unlike research institutions, universities cannot concentrate on research and neglect teaching, or it will have a significantly negative impact on the mission of training individuals.

For the above reasons, the MOE provided 1 billion NT Dollars to launch a plan to encourage teaching excellence in universities in 2005. Through a competitive awards mechanism, universities were encouraged to raise teaching quality, establish teaching performance indicators and set examples. It is hoped that through the input of the various kinds of funding mentioned above, HEIs are able to develop their own unique characteristics within the higher education system and satisfy the diverse needs of those seeking higher education. The four-year plan began in 2005 and ends in 2008. The 1 billion funding for 2005 was approved and appropriated, with 5 billion to be appropriated each year from 2006 through 2008.

#### Strategies in promoting teaching excellence

As it has shown, the MOE believes that through a competitive incentive mechanism, the teaching quality of universities can be raised and they will become the role models of teaching excellence. Moreover, the value of teaching can be recognized as the core function of the university. As to the content and strategies of encouraging teaching excellence, the MOE (2006a) has indicated as below:

1. Encouraging universities to pay attention to teaching, reinforcing their recognition of core teaching values, and guiding them to make adjustments in the teaching system to achieve the following objectives:
  - (1) Raising teaching standards
  - (2) Well-rounded curriculum planning
  - (3) Reinforcing the willingness of students to study, guiding and improving their study habits, and raising their standards

- (4) Establishing a teaching assessment system
- (5) Establishing systems to raise teaching quality
- 2. Through the incentive mechanism of dedicated funding, universities receiving funding can improve their teaching quality and performance.
- 3. Examples of developing universities with teaching excellence facilitate the climate of attention to teaching quality and develop concrete indicators for teaching excellence.

Public and private universities meeting the following requirements are eligible to apply. Due to limited educational resources and based on the principle of non-repetitive funding, universities which have received funding from the *Plan to Develop First-class Universities and Top-level Research Centers* are forbidden to apply.

In terms of the review standards, the Ministry has set clear indicators (see Appendix one). As to the review procedures, they can be divided into two stages. During Stage One, a review committee formed of academics and experts invited by the MOE conducts reviews of the written plans submitted by universities. Universities passing the first review will undergo a second review. During Stage Two, universities passing their first review may arrange for the MOE to visit the university or the university briefs the MOE for a second review. Universities with teaching excellence will be selected to receive funding. HEIs which pass the second review will receive funding based on the review results.

#### Performance evaluation and exit mechanism

In order for universities to enforce the plan and raise teaching quality, performance evaluations are conducted on universities receiving funding as the basis for deciding whether to continue funding and the amount of funding for the following year. If the university/college does not execute the plan thoroughly or executing the plan with poor results, funding for following years will be reduced or suspended. Since the purpose of the plan is to award teaching excellence, universities receiving funding shall establish a monitoring mechanism to ensure the project is executed according to plan. The MOE will establish a project office to periodically monitor execution of the plan, conduct performance reviews, and provide opinions to universities. (MOE, 2006a)

In 2005, the MOE provided 1 billion NT Dollars competitive project funding to universities. Universities submitted plans to the MOE at end of February. A second review meeting was held early May to select 13 universities which demonstrated teaching excellence.

## Other Initiatives: Plans of establishing ‘Inter-university Teaching Resource Centers’ and ‘Improving Teaching in Specialised Fields’

In 2006, there were 129 HEIs competing the grants for the second round of the ‘Program for Encouraging Teaching Excellence in Universities’. As it turned out, only 58 HEIs (28 HEIs and 30 technological HEIs in total) were awarded with funding. The funding was increased to 3.52 billion NT Dollars although the initial sum of funding was 5 billion NT Dollars. The Ministry of Education decided to reserve 30% of the fund (1.5 billion) on other new initiatives so that more HEIs can be benefited as a consequence. The two new initiatives are: ‘Inter-university Teaching Resource Centers’ and ‘Improving Teaching in Specialized Fields’. HEIs which failed to get the funding for both research excellence and teaching excellence initiatives were encouraged to apply before October 2006. The outcomes was announced the following month. The length of the project will last from November 2006 to July 2007. The key principles for the planning are to adjust curriculum and programs based on human resource needs of the industry and thus the link between HEIs and the industry can be strengthened. In so doing, it is hope that students can develop fundamental professional ability and thus enhance their employability. (MOE, 2006b)

### Inter-university Teaching Resource Centers

The aims of the plan are: establishing the platform to share resource, creating excellent teaching environment, supporting teachers’ professional development, the adjustment and improvement of curriculum, promoting teaching quality and the effectiveness of student learning. The mission and functions of these centers include: (MOE, 2006c)

- ✓ teachers’ professional development in teaching
- ✓ assisting partner HEIs in setting up teacher and teaching evaluation mechanism.
- ✓ assist partner HEIs to proceed with curriculum(program) reform, planning and adjustment
- ✓ integrate and plan general curriculum for partner HEIs
- ✓ establishing cross-HEIs curriculum and programs
- ✓ the development of excellent on-line teaching materials
- ✓ developing the tools of standardized achievement evaluation
- ✓ assisting partner universities in establishing TA system and the training of TA.
- ✓ the integration of teaching resource between HEIs
- ✓ Other approaches which can promote quality of teaching

All HEIs in Taiwan are qualified to submit plans. The length of the program will last for three years. The basic structure of a resource center should include: (1). a host university/college; (2). several partner universities/colleges; (3). a steering committee consisted of presidents from these universities, the president of the host university will be the coordinator; (4). a working group. Based on the features, need and resources of these HEIs, the annual plan should indicate the specific approaches to promote teaching quality in five dimensions: organization structure, professional development of teachers, curriculum planning, student achievement, and resource sharing between HEIs and others.

The MOE also provides specific accountability indexes for each resource center (both quantitative and qualitative accountability) (MOE, 2006c):

1. qualitative: (the university/college can increase any new items that are deemed necessary):

- (1) enhancing the professional development in teaching;
- (2) integrated teaching resources between partner HEIs as well as the neighbourhood regions and communities;
- (3) curriculum/programs reform, planning and adjustment;
- (4) the establishment of TA system and the training of TA;

2. quantitative (the university/college can increase any new items that are deemed necessary):

- (1) the total number of people and times of professional development in teaching, classroom observation workshop and professional development;
- (2) the establishment of teacher and teaching evaluation mechanism;
- (3) the total number of inter-university curriculum/programs and students
- (4) the development of high quality teaching materials which emphasized the features of Taiwan
- (5) the development of standardized achievement test tools.

In addition to the proposals submitted by the HEIs, the MOE can also establish resource centers wherever it considers necessary.

### Improving Teaching in Specialized Fields

For those universities and colleges which failed to get the funding for ‘*First-class Universities and Top-level Research Centers Scheme*’ and ‘*Program for Encouraging Teaching Excellence in Universities*’, they may apply for this scheme.

HEIs based on their features of development as well as the particular areas of the professionals



specified by the government, each department/institute/faculty can submit the plan to the universities/colleges. The purpose of the scheme is to enhance the competitiveness of students' employability. The HEIs can then submit the plan individually or they can cooperate with other universities.

The specific professional fields for national and social development listed by the MOE are: (MOE, 2006d)

- ✓ Newly developed service industry: finance, distribution and transportation services, communication and media services, medical and nursing care, human resource training, human resource dispatching and property management services, tourism, sport and leisure services, culture and creativity, design, information, research & development, environment protection, engineering consultancy;
- ✓ ageing society-related industry: health care, social care, accommodation, transportation, leisure industry;
- ✓ in-service training of secondary and primary school teachers;
- ✓ ocean, marine, fishing, marine engineering, renewable energy, intell. robot, drug testing etc.;
- ✓ improvement of general education curriculum;
- ✓ improvement of basic knowledge and skills for students in technical and vocational colleges and universities.

The length of the program should last for three years (2006-2009). Again, the program should focused on three dimensions: (MOE, 2006d)

1. teachers: professional development of teachers; supporting mechanism for teaching, rewards for teaching excellence
2. curriculum/program: the design meets the need of the industry and enhance the employability of students; proper curriculum and teaching evaluation mechanism; instruction design combined with theories and practices
3. students: evaluation of students, supervision in learning, flexibility in taking courses, development of multiple abilities, career orientation of the graduates.

In addition, an internal evaluation mechanism should be included in the proposal.

The Features of Developing Strategies in Teaching Excellence in Taiwan

Common approaches in the 13 universities

### The emphasis of e-learning and technology

In the strategies of promoting teaching excellence in the 13 universities, we can see all 13 universities place great importance in e-learning and teaching. Jenkins, Breen & Lindsay (2003) suggest that the linked processes of globalization and information and communications technology are changing the classic connections of academics as teacher/researchers working with students in fixed locations (p.146).

### The development of work-related capability

Due to the market pressure, it also shows that most of the initiatives place great importance on the employability of graduates. In particular, when examine the plan '*Improving Teaching in Specialized Fields*', it is not hard to see that the government only fund certain specific fields which are considered important for the national and social development of the country.

### The emphasis of international exchange and foreign language learning

Internationalization of higher education is another key element in promoting teaching excellence in Taiwan. Needless to say, the nation-wide university program evaluation which started in 2006 also contributes to the pace of internationalization as it is one of the key criteria.

### The key role about professional development of teachers

Teachers' professional development occupies an important role in all 13 universities. Nevertheless, what does it intend to achieve and to what extent its goals can be achieved is another interesting theme remained to be explore. What is the definition of 'professionalism' in the 21<sup>st</sup> century? It will surely take some time for university leaders and managers to contemplate the answer. As HEIs in Taiwan have always placed great importance in research production, how can university managers persuade teachers to think otherwise is an importance issue.

### The introduction of TA systems

It is also clear that the introduction of TA systems is also a key element of the scheme. While

more students may have benefited from frequent contacts and tutorials with TAs, teachers often found that their workload may not necessarily be reduced.

### Globalization and pedagogy

The impact of globalisation is another important element to take into consideration. David Harvey (1991) suggests that although globalization is not a new phenomenon, its significance has been radicalized in the contemporary period by the development of information and communication technologies. Richard Edwards and Robin Usher (1997) further indicate that 'globalization results in and from an increased economic integration within a framework of the market, and with this the emphasis on education transmitting, a national culture becomes displaced by a focus on education's role in servicing the global economy wherein each nation is embraced by the logic of competitiveness. Education practices therefore come both to service and contribute to the intensifying processes of globalization' (p. 137).

They further suggest that the growth and development of open and distance learning, the increased emphasis on computer-based learning, the development of international markets by educational institutions, the emphasis on non subject-specific generic and transferable capabilities and the prevalence and spread of English as the medium for the curriculum can be seen as the evidence. They believe that such a pedagogy may contribute further to the individualizing process and undermine the possibilities for collective learning and Endeavour as differences is asserted over shared circumstances and interests. The strategies of promoting teaching excellence taken by the 13 universities in Taiwan show that globalization has played a significant role in shaping the national policies of teaching excellence in higher education.

Nevertheless, how the force of globalization and the pursuit of teaching excellence in Taiwan will transform the landscape of HE pedagogy on the island need more detailed examination.

Some concluding thought about teaching excellence

A new managerial and performative state of higher education

It is not difficult to see the influence of managerialism in the development of higher education in Taiwan. Following the global trend, approaches such as the introduction of a quasi-market system, decentralization as well as the emphasis on accountability and performance management can be seen in Taiwan since 1990s. Thus, establishing the national evaluation mechanism in higher education

sector seems to be inevitable and the Ministry is actively working on ensuring assessments for the highest quality of research and teaching are achieved.

It is clear that the whole movement in raising teaching quality is driven by the national government. The pursuit of global competitiveness is the main concern. Alan Jenkins, Rosanna Breen & Roger Lindsay (2003) argue that there is a need to examine the issue at the national and international levels. This is because some national governments take a very proactive and direct role in determining the organization of and purposes of universities, both for teaching and for research; and also in reviewing how universities are meeting national needs. (p.145) The development of national policies teaching excellence in Taiwan clearly provides the best example.

Moreover, as we examine all these schemes and strategies in promoting teaching excellence in Taiwan, we found that the central government has limited the scope of promoting teaching excellence as it has shown in Appendix One. Thus, unless HEIs move towards the direction that the Ministry has desired, they are unlikely to receive funding.

In appearance, the autonomy of HEIs seems to be increasing after the amended University Law was promulgated in 2005. But this may not be the case as universities may have realized that they are obligated to move toward certain directions in order to gain funding and to be ranked highly. American scholar Kells (1999) indicates that in search of financial stability and continuity, university leaders in the late 20<sup>th</sup> century have often ‘permitted the State and its agents to gain the initiative in and the control of quality, the setting of standards and the matters of reasonable assurance to our clients.’ The case of Taiwan seems to have confirmed this argument.

### The working experience of academics

How do these changes reflect on academics who are working in the higher education sector? The author argues that they have to learn to live with evaluation as well as learn to keep balance between teaching and researching. Under this performative culture, both university managers and academic staff are required to master the practices and absorb the values in order to score high and thus to ensure their survival.

On the other hand, staff working in higher education need to keep balance between research and teaching. The supreme status of research in higher education has been reconfirmed again and again through numerous policies in Taiwan. Without exception, most HEIs set the criteria for promotion with a high demand for research productivity. Interestingly, although the government intends to classify universities and virtually all so-called ‘research universities’ are public universities, there is not much difference in the promotion criteria between different HEIs.

The teaching-research linkage is not automatic and in many ways is problematic

According to Brenda Smith and Sally Brown's research finding in the UK (1995: 14-5), in some disciplines and departments, it is relatively easy to ensure that the research one is undertaking is closely linked to the subjects one is teaching that the two activities support each other. But many academics are less lucky. Alan Jenkins, Rosanna Breen & Roger Lindsay (2003:144) also suggest that teaching-research linkage is not automatic and indeed in many ways is problematic. However, they also believe staff's research can aid student learning and motivate students.

In Taiwan, through other funding initiatives such as '*Program for Encouraging Teaching Excellence in Universities*', academics working in non-elite universities are caught in a dilemma as they are required to spend more time and energy on developing good teaching practices rather than engaging in their own research. In the UK, Smith and Brown (1995: 14) have similar findings that:

*.....lecturers from the new universities are expected to be active in both research and teaching, although rarely is compensatory time allowed to enable meaningful research to be undertaken. Many university lecturers are finding that they are under pressure to teach more and more students with no more resources, just at a time when they are expected to produce graduates with a range of skills and abilities attractive to employers: simultaneously lecturers are urged to adopt new, creative and student-centred teaching approaches.* (Smith and Brown, 1995: 14)

As a result of globalization, there is little doubt that academics in Taiwan share similar experiences with the British academics that Smith and Brown have described.

The need of critical examination about the concept of teaching excellence

Alan Skelton (2005) reminds us that teaching excellence is a contested concept which is historically and situationally contingent (p.11). This means that there are different understanding of what good teaching excellence means and how to practice it. He further comments that current policies which aim to recognize, reward and promote teaching excellence in higher education need to be examined in the light of their assumption. "“Rational-purposive” policies, favoured by politicians and institutional managers, are overly rational and coherent, and fail to recognize that policies of teaching excellence are always subject to creative interpretation on the ground”. Thus he advises us ‘what policies as texts reveal about teaching excellence in higher education has to be set against the reality of how policies are received and interpreted.’ (p. 14) Watkins (1998) also share similar views that what constitutes good teaching is often based on Western conceptions and that

there have been many evidences showing that the cross-cultural differences of teaching excellence do exist.

Skelton (2005:9) also points out that higher education teaching traditionally has been ‘placed too much attention on the act of teaching and given insufficient regard to what students learn in the educational encounter.’ Is teaching fundamentally about transferring information from the teacher to the learner, or is it about creating contexts which makes learning possible? Michael Prosser and Keith Trigwell (1999) also argue that learning and teaching are fundamentally related, that good teaching needs to be defined in terms of helping students learn. In other words, the learning of students should be the focus of good teaching, not teaching activities of teachers (p.11). Frank Newman, Jamie Scurry and Lara Couturier (2004) also stress that ‘a commitment from faculty, administrators and students is critical to move teaching and learning to the center of the institution where all share in the responsibility for student learning’ (p.148).

While the global trend of pursuing teaching excellence is inevitable and a higher level of teaching accountability has been demanded, it is necessary for us to develop a more critical view of teaching and learning excellence.

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