#### **VIETNAM**



#### Source: esri

#### General

Vietnam - officially the Socialist Republic of Vietnam - is the easternmost country on the Indochina Peninsula in Southeast Asia. Vietnam is bordered by China in the North, Laos in the Northwest, Cambodia in the Southwest, Thailand across the Gulf of Thailand in the Southwest, and the Philippines, Malaysia and Indonesia across the South China Sea in the East and Southeast. The area of Vietnam is 33.1 Mha (million hectares) with, in 2022, a population of 98.2 million, or 3.0 persons per ha (Wikipedia and United Nations, 2022).

# Climate and geography

Because of differences in latitude and the variety in topographical relief, the climate varies considerably from place to place. During the winter or dry season, extending roughly from November to April, the monsoon winds usually blow from the Northeast along the Chinese coast and across the Gulf of Tonkin, picking up considerable moisture. Consequently, the winter season in most parts of the country is dry by comparison with the rainy or summer season. The average annual temperature is generally higher in the plains than in the mountains, and higher in the South than in the North. Temperatures vary less in the southern plains around Ho Chi Minh City and the Mekong Delta, ranging between 21 and 28 °C over the course of the year (source: Wikipedia).

The combined length of Vietnam's land boundaries is 4,639 km, and its coastline is 3,444 km long. At its narrowest point in the central Quang Bình Province, the country is as little as 50 km across, though it widens to around 600 km in the North. Vietnam's land is mostly hilly and densely forested, with level land covering no more than 20%. Mountains account for 40% of the country's land area, and tropical forests cover around 42%. The Red River Basin in the North stretches over an area of 130,000 km² and is marked by steep slopes. The Red River Delta, a flat, roughly triangular region covering 15,000 km², is smaller but more intensely developed and more densely populated than the Mekong River Delta in the South. Once an inlet of the Gulf of Tonkin, it has been filled in over the millennia by riverine alluvial deposits. The delta, covering about 40,000 km², is a low-level plain no more than 3 m+MSL (mean sea level) at any point. It is criss-crossed by a maze of rivers and canals, which carry so much sediment that the delta advances 60 to 80 m into the sea every year. Southern Vietnam is divided into coastal lowlands, the mountains of the Annamite Range, and extensive forests. Comprising five relatively flat plateaus, the highlands account for 16% of the country's arable land and 22% of its total forested land. The soil in much of the southern part of Vietnam is relatively low in nutrients as a result of intense cultivation (source: Wikipedia).

Several minor earthquakes have been recorded. The northern part of the country consists mostly of highlands and the Red River Delta. From North to South Vietnam, the country also has numerous islands, with Phú Quốc as the largest. The Ba Bể Lake and Mekong River are the largest lake and longest river in the country (source: Wikipedia).

In the winter time water levels in all rivers are low and salinity intrudes very far, up to 20 - 25 km from the coast (Vinh, 1997). Flooding usually originates in China. Inundation of inland caused by heavy rainfall usually occurs between July and September.

Devienne (2006) describes that the Red River is a dangerous river, with multiple, violent and relatively short-term floods. Most of the water that it carries along in flood periods does not come from rainfall on the delta itself, but from regions located upstream in the river basin. In Hanoi, the river reaches 2.5 m at its lowest water level, whereas when floods are strongest, it can rise up to 11.5 m or even 13 m. Throughout the delta, three types of land are encountered. They can be differentiated as a function of their relative altitude in relation to the level of water, i.e., in relation to the availability of water depending on the different seasons and on the risks of flooding. Before impoldering the lowlands were submerged in the rainy season by rainwater and, every other year, by the overflow of the water carried by the floods. In winter they were

marshy, and in a large part of the delta they could be flooded at high tide. The midlands were submerged in the summertime, by floods; whereas they were preserved from floods in the summer by the overflow of the floods in the mid- and lowlands.

Devienne (2006) further describes that although the delta was settled long ago, probably dating back to the first millennium BC, it was in the 11<sup>th</sup> century that the delta population tackled large-scale hydraulic projects. In the Red River delta, the Chinese introduced techniques (use of the plough and undoubtedly also the rice transplanting technique), as well as their political and administrative system relying on a body of paid and revocable civil servants, the mandarins. Mandarin bureaucracy organized the work of the peasants and collected a tribute tax, to conduct major hydraulic projects the scope and coordination of which required centralization. The projects were aimed progressively at safeguarding the land from salt water intrusions, at protecting the whole delta from floods in the Red River and its distributaries, then at favouring the drainage of land in the rainy season and finally irrigate the land in the dry season. Those projects were conducted in phases, by each of the major dynasties that came to power one after the other; they relied on the construction of canals, dikes, equipped with floodgates, and on gravitational drainage using, when possible, the ebb and flow of the tides.

From the 11<sup>th</sup> century, the first major projects consisted of constructing canals, i.e., deepening drains and compartment rivers, to favour the drainage of land, and especially constructing dikes making it possible to protect the coastal zones from intrusions of brackish water. Then, from the 13<sup>th</sup> century, the Vietnamese set about diking up the Red River and its main distributaries, the Canal des Rapides and the Canal des Bambous, to avoid flooding related to excessively high floods. The dike building was to last a long time. The dikes had to be continually reinforced, and the network supplemented: in the 18th century, the Day river, a Red River distributary, was in turn diked up. From then on, the Red River crossed the delta and was no longer involved in drainage or alluvial deposits: the evacuation of rainwater and flood tides had to be done via the numerous drains and compartment rivers as well as via their small tributaries that were gradually deepened. As from the end of the 19th century, the French colonial administration followed the bureaucracy already set up and pursued those works by mobilizing the peasant workforce and increasing its fiscal pressure. The dikes encircling the Red River and its distributaries were reinforced, the drainage of the western region was improved owing to the dam upstream on one of the Red River distributaries, the Phu Ly Canal, thus keeping the floods from spilling into the lowlands. Many drains were deepened to enhance land drainage. From the early 20<sup>th</sup> century, the colonial administration embarked on irrigation network projects, which were still fairly limited (they concerned 60,000 ha out of approximately 1.2 Mha. The gravitational irrigation was enabled by the construction of diversion canals upstream on the rivers. A pumping station in the upstream zone of the delta was installed, making it possible to raise the water of the Red River and irrigate the highlands (Devienne, 2006).

Horticultural crops and fruit trees are also grown on soils, which are generally considered as being less suitable for such crops, and where frequent flooding occurs. Small polders have been built with pump-lift drainage and irrigation by sprinkling. There is a liberal application of fertilizers, and if necessary, lime. Such areas are found in the vicinity of cities where a good market exists for such products making high investments justifiable (Ho Chi Minh City, My Tho and Can Tho) (Centre for Civil Engineering Research and Codes (CUR) and Ministry of Transport, Public Works and Water management, 1993).

Due to sedimentation in the downstream section the bed of the Red River has risen several metres above the level of the adjacent land (Centre for Civil Engineering Research and Codes (CUR) and Ministry of Transport, Public Works and Water management, 1993).

McElwee et al. (2016) describes that the Northern, Central, and Southern regions of Vietnam traditionally had divergent ways of coping with flood hazards. He states that the lack of information about and attention to flood risk and vulnerability in the Red River Delta, is likely due to the

misperception that the Red River Delta has sufficient infrastructure in the form of dams and dikes to prevent large-scale flooding. Here floods usually occur primarily after storms or extreme rainfall events, and the focus has been on infrastructure for flood prevention, including investments in reservoirs, river and sea dikes, and dredging. Other areas of Vietnam have seen much more research. In the Mekong Delta, slow-onset yearly floods have prompted an adaptation regime of *living with the floods*, while in Central Vietnam short slopes and high risk of flash floods have focused efforts on preparedness and disaster risk reduction projects.

Biggs (2011) describes about the Mekong Delta that, starting the late 1930s, rather than redesign the waterway system, the colonial government embarked upon a *Dutch dike strategy* for flood control that has had long-term consequences extending to the present day. Rather than figure out ways to drain water from agricultural areas, the government instead experimented with building encircling flood dikes or polders (*casiers*) that would at least protect lands inside.

Minderhoud (2019) describes in detail the present and future subsidence in the Vietnamese part of the Mekong Delta. The present rates can be up to  $\approx$ 35 mm/year at the coastline. He describes and shows the various drivers of the subsidence (Figure 1).

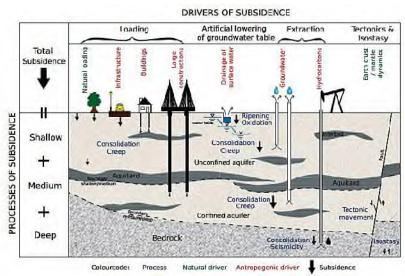


Figure 1. Main drivers and processes of subsidence in a deltaic system. Subsidence drivers and processes act at different depths and time intervals. Generally, subsidence processes in the shallow subsurface cause local subsidence, while deeper processes can affect much larger areas (Minderhoud, 2019)

### **Existing polders**

The Group Polder Development (1982) mentions the following polder projects in the Mekong Delta (Figure 2):

- Cai San (60,000 ha);
- Quan Lo Phung Hiệp (600,000 ha) near Bassac River;
- Tiêp Nhut (34,000 ha);
- Ba Dong (110,000 ha) along the coast;
- South Kiên Hoa (30,000 ha) along the coast;
- Ba Tri (37,000 ha) along the coast;
- Go Cong (50,000 ha).

Ritzema *et al.* (2011) did research in the Trieu Dong and Phan Dong polders to improve water management in the Red River Delta.

Wikipedia mentions the Phuong Dong polder (790 ha).

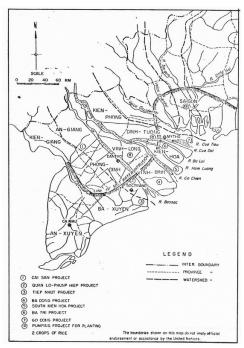


Figure 2. Polder projects in the Mekong Delta (Group Polder Development, 1982)

Tessier (2011) shows a map of the dikes in the Red River Delta in 1905 that is derived from Gauthier (1930) (Figure 3). The Group Polder Development (1982) also shows a map of the dikes in the Red River Delta (Figure 4). This map is probably of a later date.

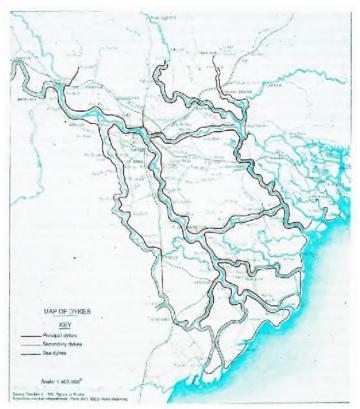


Figure 3. Dikes in the Red River Delta in 1905 (Tessier, 2011, after Gauthier, 1930)

General characteristics of the polders in Vietnam are shown in Table I. Table II shows the characteristics of the water management and flood protection systems of the existing polders.

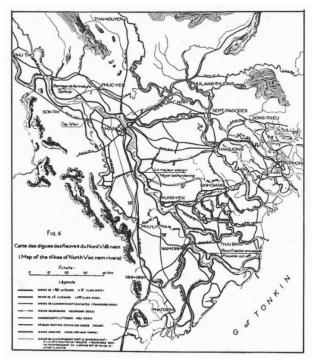


Figure 4. Polders in the Red River Delta (Group Polder Development, 1982)

## **Proposed polders**

No proposed polders have been identified.

### Water management and flood protection

Water management in the Red River Delta involves flood control, water supply and drainage. A dike system with a length 2,100 km and 500 sluices, irrigation and drainage has been constructed over the last centuries, especially since 1960. There are three typical types of drainage in this region (Vinh, 1997):

- by gravity in highly elevated land;
- by using tidal fluctuation, there are 15 schemes with a total drainage area of about 410,000 ha;
- by pumping, an area of about 400,000 ha is drained by pumping of various types and capacity of each unit, ranging from 1,000 m<sup>3</sup>/hr to 30,000 m<sup>3</sup>/hr.

Vinh Tran Si (1997) describes that the discharge capacity of the drainage systems in the Red River Delta is based on 4 l/s/ha, 35 mm/day, which he considers as too low.

As far as the soil in the Mekong Delta is concerned, several sources describe that the development of acid-sulphate soil (catclay) due to reclamation occurs at a large scale (Group Polder Development, 1982; Stamhuis, 1983). Stamhuis (1983) describes research in a pilot polder focussed on finding the best water management options for rice cultivation at potentially acid-sulphate soils.

Tran and Weger (2018) give a schematic presentation of the irrigation and drainage systems (Figure 5). They also show the existing low and high dike areas (situation 2014) in An Giang Province in the Mekong Delta (Figure 6).

As far as flood protection is concerned Van Alphen and Lodder (2006) describe that Vietnam applies safety levels based on chances of occurrence from 0.5% per year till 4% per year.

Pilarczyk and Nuoi (2005) state that because of the specific situation of the Mekong Delta it is neither economically justified nor environmentally sound to provide complete flood protection. The actual policy recommendations include:

- low embankments in the deeply flooded parts to protect against early floods;
- full embankments in shallow agricultural areas to protect against 10-year floods;
- no embankments on land that has potentially serious acid-sulphate problems.

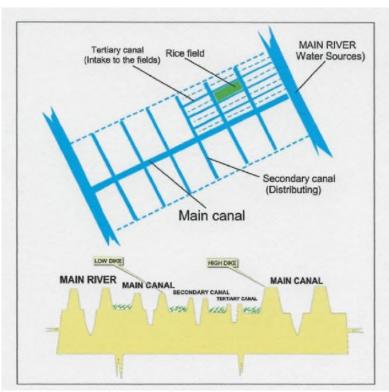


Figure 5. Schematic presentation of the irrigation and drainage systems in An Giang Province in the Mekong Delta (Tran and Weger, 2018)

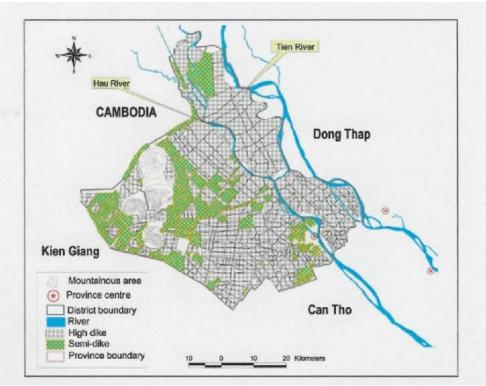


Figure 6. Low and high dike areas (situation 2014) in An Giang Province in the Mekong Delta (Tran and Weger, 2018)

## Location of the polders in Vietnam as shown on the World polder map

The location of the polders in Vietnam is shown in Figure 7.



Figure 7. Location of the polders in Vietnam (source: esri – Batavialand)

The pictures by Prof. Adriaan Volker are shown in Table III. The pictures by Prof. Bart Schultz are shown in Table IV.

### References

Alphen, J. van and Q. Lodder, 2006. Integrated flood management: experiences of 13 countries with their implementation and day-to-day management. *Irrigation and Drainage*. 55.S1. 159-171.

Anderson, H.R., 1978. *Hydrogeological reconnaissance of the Mekong Delta in South Vietnam and Cambodia*. Geological Survey Water Supply, Paper 1608-R, Washington, USA.

Biggs, D. 2011. Fixing the delta: history and the politics of hydraulic infrastructure development and conservation in the Mekong Delta. In: Environmental change and agricultural sustainability in the Mekong Delta, eds. M.A. Steward and P.A. Coclanis, 35-44. Springer. New York, USA.

Bouma, J., 2019. Bodemdaling is niet alleen in Nederland een probleem. In Vietnam lopen 18 miljoen mensen gevaar. *Trouw*, 25 February (in Dutch).

Centre for Civil Engineering Research and Codes (CUR) and Ministry of Transport, Public Works and Water management, 1993. *Hydrology and water management of deltaic areas*. CUR report 93-5. Gouda, the Netherlands

Committee for Coordination of Investigations of the Lower Mekong Basin, 1970. *Training course for hydrologic data processing*. Proceedings and Papers. Bangkok, Thailand.

Committee for Coordination of Investigations of the Lower Mekong Basin, 1970 - 1973.

- *An introduction to the report on Indicative Basin Plan;*
- Planning and the Mekong Project;
- *Public health and the Mekong Project;*
- *Ecology and the Mekong Project;*
- Fish and the Mekong Project;

Dang, N.M/, M.S. Babel and H.T. Luong, 2011. Evaluation of flood risk parameters in the Day River Flood Diversion Area, Red River Delta, Vietnam. *Nat Hazards* 56:169–194. doi:10.1007/s11069-010-9558-x.

Devienne, S. 2006. Red River Delta: fifty years of change. *Moussons* 9–10:255–280. doi:10.4000/moussons.2042.

Dinh, Q., S. Balica, I. Popescu and A. Jonoski, 2012 Climate change impact on flood hazard vulnerability and risk on the long Xuyen Quadrangle in the Mekong Delta. *International Journal of River Basin Management*.

Fontenelle, J-P., Dao The Anh, P. Defourny and Dao Thê Tuân, (eds), 2000, *Atlas of Bac Hung Hai Polder*. Agricultural Publishing House. Hanoi, Vietnam.

- Gagliano, S.M. and W.G. McIntire, 1968. *Reports on the Mekong River Delta*. Coastal Studies Institute, Louisiana State University, Baton Rouge, Louisiana, USA.
- Gauthier, J. 1930. Digues du Tonkin. Exposition coloniale internationale. Paris, France.
- Government of the Netherlands, Ministry of Foreign Affairs and Government of Vietnam, Ministry of Agriculture and Rural Development, 2002. *Day River flood diversion and water resources development project Vietnam*. Final report, Main report. (only in print)
- Group Polder Development, Department of Civil Engineering, Delft University of Technology, 1982. *Polders of the World. Compendium of polder projects.* Delft, the Netherlands.
- Hai, V.V., 1996. Assessment of the effect of the reclamation of acid sulphate soils for agricultural development in Vietnam. MSc Thesis, IHE. Delft, the Netherlands.
- Hens, L., Nguyen An Thinh, Tran Hong Hanh, Ngo Sy Cuong, Tran Dinh Lan, Nguyen Van Thanh and Dang Thanh Lin, 2018. Sea level rise and resilience in Vietnam and the Asia-Pacific: a synthesis. *Vietnam Journal of Earth Sciences* (40)2.
- Hien, H.M., T.N. Trung, W. Looijen and K. Hulsbergen, 2005. *Flood vulnerability analysis and mapping in Vietnam*. In: van Oosterom, P., S. Zlatanova and E. Fendel (eds). Geo-information for disaster management. Springer, Dordrecht, the Netherlands. pp 67–83.
- Hung, H.V., R. Shaw and M. Kobayashi, 2010. Flood risk management for the riverside urban areas of Hanoi: the need for synergy in urban development and risk management policies. *Disaster Prevention and Management* 19:103–118. doi:10.1108/09653561011022171.
- Joint Development Group, 1967. A program for Mekong Delta Development. Working Paper No. 3. Saigon, South Vietnam.
- Korteweg, A.L., 1975. Waterbouwkunde in de delta van de Mekong. *Intermediair*. 11<sup>e</sup> jaargang 47 21 november (in Dutch).
- Lempert, R., N. Kalra, S. Peyraud, Z. Mao, S.B. Tan, D. Cira and A. Lotsch, 2013. *Ensuring robust flood risk management in Ho Chi Minh City*. World Bank Policy Research Working Paper 6465, Washington DC, USA.
- Minderhoud, P.S.J., 2019. *The sinking mega delta*. PhD Thesis Utrecht University. Utrecht, the Netherlands.
- Ministry of Natural Resources and Environment (MONRE), 2009. Climate change, sea level rise scenarios for Vietnam, Hanoi, Vietnam.
- Neumann, J., K. Emanuel, S. Ravela, L.C. Ludwig and C. Verly, 2015. Risks of coastal storm surge and the effect of sea level rise in the Red River Delta, Vietnam. *Sustainability* 7:6553–6572. doi:10.3390/su7066553.
- Olson, K.R. and L.W. Morton, 2018. Polders, dikes, canals, rice, and aquaculture in the Mekong Delta. *Journal of Soil and Water Conservation*, vol. 73, no. 4.
- Pilarczyk, K.W. and N.S. Nuoi, 2005. Experience and practices on flood control in Vietnam. *Water International*. Vol. 30, issue 1.
- Ritzema, H., Le QuangAnh and Bui Thi Kim, 2011. *Collaborative research to improve the water management in two polders in the Red River Delta in Vietnam*. Chapter 3. In: A. Paassen, J. Berg, E. Steingröver, R. Werkman and B. Pedroli. Knowledge in action. Mansholt Publication Series. E-Book.
- Stamhuis, E., 1982. *Cultuurtechnisch tijdschrift* Een proefpolder voor onderzoek van kattekleien in de Mekong Delta., Jaargang 22, nr. 2. Aug./sept. '82. (in Dutch).
- Stamhuis, E., 1983. A experimental polder for research on acid sulphate soils in the Mekong Delta. In: Proceedings International Symposium 'Polders of the World'. International Institute for Land Reclamation and Improvement, Wageningen, the Netherlands.
- Staveren, M. van, 2017. Bringing in the floods: a comparative study on controlled flooding in the Dutch, Bangladesh and Vietnamese deltas. PhD thesis. Wageningen University & Research. Wageningen, the Netherlands.
- Steketee, H., 2013. Nederlandse waterbouw poldert in de hele wereld. NRC.NL. 9 march (in Dutch).
- Tessier, O., 2011. Outline of the process of Red River Hydraulics Development during the Nguyen Dynasty (Nineteenth Century). In: M.A. Stewart and P.A. Coclanis (Eds.). Environmental change and agricultural sustainability in the Mekong Delta. Springer. Dordrecht, Heidelberg, London, New York.

- The Netherlands Delta Development Team, 1974. Recommendations concerning agricultural development with improved water control in the Mekong Delta. Main report, Annex A and B. Committee for the Coordination of the Investigations of the Lower Mekong Basin and Kingdom of the Netherlands, Ministry of Foreign Affairs, International Technical Assistance Department. Bangkok, Thailand.
- Thuan, N.D., 1998. Land reclamation and rice cultivation measures on severe acid sulphate soils in the Plain of Reeds, Mekong delta, Vietnam. MSc Thesis, IHE. Delft, the Netherlands.
- Toan, T.Q., 1998. Flood protection and reclamation of acid sulphate soils in the Mekong delta, Vietnam. MSc Thesis, IHE. Delft, the Netherlands.
- Tran, D.D. and J. Weger, 2018. Barriers to implementing irrigation and drainage policies in An Giang Province, Mekong Delta, Vietnam. *Irrigation and Drainage*. 67.S1. 81-95.
- United Nations, 1957. Development of water resources in the Lower Mekong Basin. Flood Control Series No. 12. Bangkok, Thailand.
- United Nations, Department of Economic and Social Affairs, Population Division. 2022. World population prospects, medium prognosis. The 2022 revision. New York, USA.
- Van P.D.T., I. Popescu, A. van Griensven, D.P. Solomatine, N.H. Trung and A. Green, 2012. *A study of the climate change impacts on fluvial flood propagation in the Vietnamese Mekong Delta*. Hydrology and Earth System Sciences. 16
- Vinh Tran Si, 1997. *Country reports C11*, In: Proceedings Volume 1, 7th ICID International Drainage Workshop,' Drainage for the 21st Century, 17 21 November, Penang, Malaysia.
- World Bank, 2019. Vietnam: toward a safe, clean, and resilient water system. Washington DC, USA.

Bart Schultz

Lelystad, December 2023

Table I. General characteristics of existing polders in Vietnam

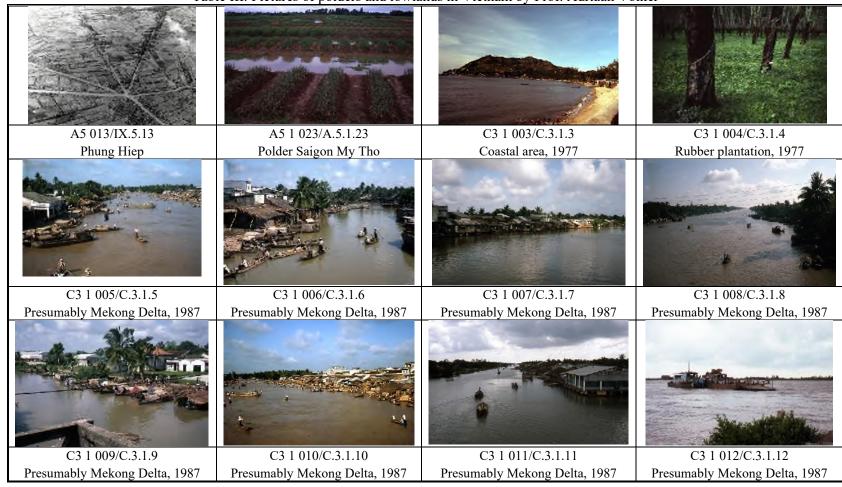
Name	Reclamation	Area in ha	Type *)	Latitudes	Longitudes	Elevation in m+MSL	Land use
Red River Delta:							
<ul> <li>Phan Dong Polder</li> </ul>		1,956	RLL	21° 13' N	106° 4' E	2 - 4	Agriculture
Phuong Dong polder	1997	790	RLL	21° 03' N	106° 43′ E	10	Rural area
Polders with pumped drainage		400,000	RLL	20° 42' N	106° 30' E	2	Rural area
• Polders with tidal gravity drainage		410,000	RLL	21° 03' N	106° 30' E	2	Rural area
Trieu Dong Polder		4,051	RLL	20° 38' N	106° 7' E	1.3 - 3.0	Mixed land use
Mekong Delta:							
Ba Dong		110,000	RLL	9° 40' N	106° 33' E	2	Rural area
• Ba – Tri		37,000	RLL	10° 02' N	106° 36′ E	-1	Rural area
Bac Hung Hai Polder							
• Cai San		60,000	RLL	10° 19' N	105° 28' E	2	Rural area
Go Cong		50,000	RLL	10° 22' N	106° 41' E	2	Rural area
• Quan Lo		600,000	RLL	9° 28' N	105° 30' E	0	Agriculture
• South Kiên – Hoa		30,000	RLL	9° 51' N	106° 37' E	-1	Agriculture
• Tiêp – Nhut		34,000	RLL	9° 28' N	106° 10' E	1	Agriculture
Total		1,737,797					

<sup>\*)</sup> RLL = reclaimed low-lying land; LGS = land gained on the sea; DL = drained lake

Table II. Characteristics of the water management and flood protection system of existing polders in Vietnam

	Design criteria in chance of occurrence/year							
Name	Water management						Flood protection	
	Drainage						D.mo1	I Iula on
	Design	Design	Percentage of	Discharge capacity		Irrigation	Rural	Urban
	Type	criterion	open water	$m^3/s$	mm/day		%/year	%/year
Red River Delta:					35		0.5 –	4.0
Phan Dong Polder	RLL							
Phuong Dong polder	RLL							
Polders with pumped drainage	RLL							
Polders with tidal gravity drainage	RLL							
Trieu Dong Polder	RLL							
Mekong Delta:								
Ba Dong	RLL							
Ba – Tri	RLL							
Bac Hung Hai Polder							0.5 -	4.0
Cai San	RLL							
Go Cong	RLL							
Quan Lo	RLL							
• South Kiên – Hoa	RLL							
• Tiêp – Nhut	RLL			<u>'</u>		·		

	Table III. Pictures of polders and low	ands in victiani by 1101. Aditadii	VUIKCI
A5 001/IX.5.1	A5 002/IX.5.2	A5 003/IX.5.3	A5 004/IX.5.4
Aerial picture Ngan Ro Dam	Ngan Ro Dam	Ngan Ro Dam	Ngan Ro Dam
			897
A5 005/IX.5.5	A5 006/IX.5.6	A5 007/IX.5.7	A5 008/IX.5.8
Ngan Ro Dam	Ngan Ro Dam	Aerial picture Ngan Ro Dam	Prof. Adriaan Volker in polder area
A5 009/IX.5.9	A5 010/IX.5.10	A5 010A/IX.5.10A	A5 011/IX.5.11
Prof. Adriaan Volker in polder area	Prof. Adriaan Volker in polder area	Prof. Adriaan Volker in polder area	Phung Hiep



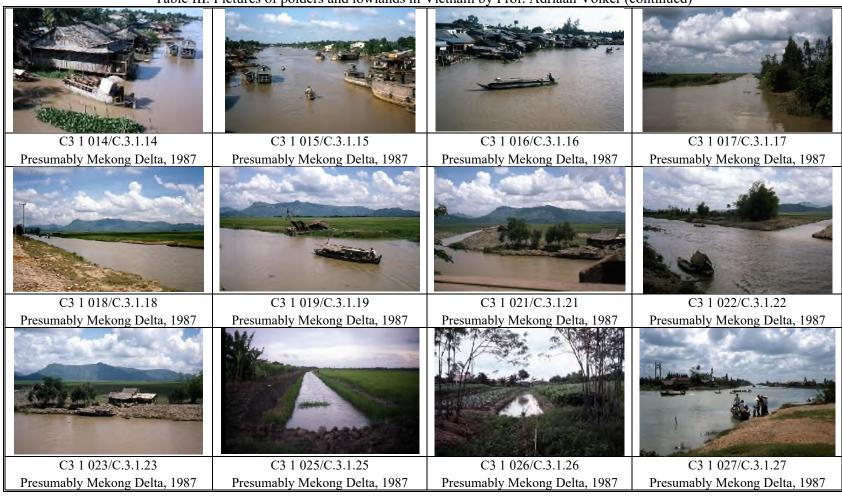








Table III. Pictures of polders and lowlands in Vietnam by Prof. Adriaan Volker (continued)

C3 2 069/C.3.2.69	C3 2 071/C.3.2.71	C3 2 072/C.3.2.72	C3 2 073/C.3.2.73
Distribution structure in irrigation canal, presumably in the area of the Red River	Bay	Bridge under construction, presumably in the area of the Red River	River, presumably in the area of the Red River
C3 2 074/C.3.2.74	C3 2 075/C.3.2.75	C3 2 076/C.3.2.76	C3 2 077/C.3.2.77
Aerial picture, presumably of a part of the area of the Red River	Farmer with buffalo, presumably in the area of the Red River	Distribution structure in an irrigation canal, presumably in the area of the Red River	Irrigation canal, presumably in the area of the Red River
C3 2 078/C.3.2.78	C3 2 079/C.3.2.79	C3 2 080/C.3.2.80	C3 3 001/C.3.3.1
Coastal area	Weir and bridge in an irrigation canal	Aerial picture, presumably of a part of the area of the Red River	Aerial picture, presumably in the area of the Red River



Table III.	Pictures of polders and lowlands in	Vietnam by Prof. Adriaan Volker (co	onunuea)
C3 3 016/C.3.3.16	C3 3 020/C.3.3.20	C3 3 021/C.3.3.21	C3 3 022/C.3.3.22
Vegetable cultivation and rice, presumably in the Mekong Delta	River, presumably in the Mekong Delta	River, presumably in the Mekong Delta	River, presumably in the Mekong Delta
C3 3 023/C.3.3.23	C3 3 024/C.3.3.24	C3 3 025/C.3.3.25	C3 3 026/C.3.3.26
River, presumably in the Mekong Delta	River, presumably in the Mekong Delta	Bananas and rice, presumably in the Mekong Delta	Bananas and maize or tobacco, presumably in the Mekong Delta
C3 3 030/C.3.3.30	C3 3 031/C.3.3.31	C3 3 033/C.3.3.33	C3 3 034/C.3.3.34
River, presumably in the Mekong	River, presumably in the Mekong	Canal bank, presumably in the	Fish pass and salt pans,
Delta	Delta	Mekong Delta	presumably in the Mekong Delta

Table III. Pictures of polders and lowlands in Vietnam by Prof. Adriaan Volker (continued)



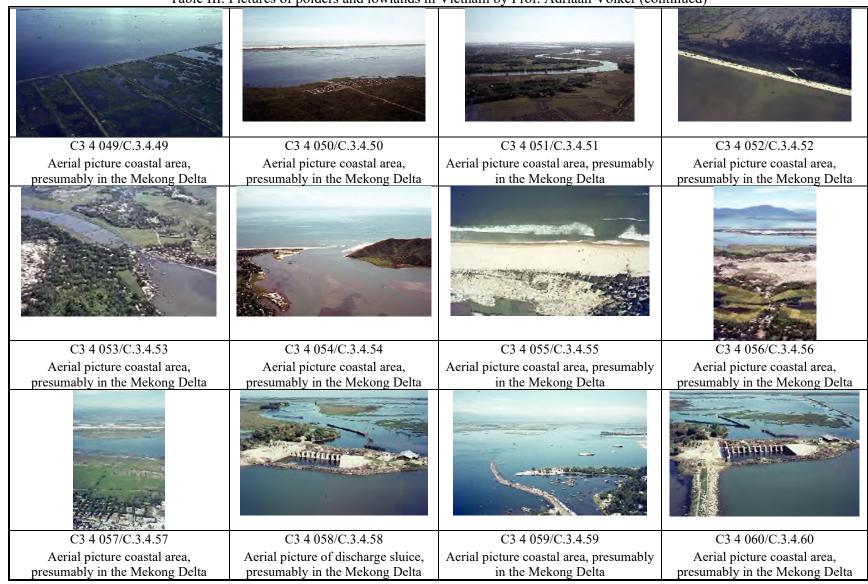


Table III. Pictures of polders and lowlands in Vietnam by Prof. Adriaan Volker (continued)











Table III. Pictures of polders and lowlands in Vietnam by Prof. Adriaan Volker (continued)

Table 1	ii. Fictures of polders and lowiands in	Victialli by 1101. Adilaali Volkel (ed	minucu)
D6 1 012/D.6.1.12	D6 1 013/D.6.1.13	D6 1 014/D.6.1.14	D6 1 015/D.6.1.15
Aerial picture of buildings,	Aerial picture lowland area,	Aerial picture lowland area,	Aerial picture lowland area,
presumably Mekong Delta	presumably Mekong Delta	presumably Mekong Delta	presumably Mekong Delta
D6 1 016/D.6.1.16	D6 1 017/D.6.1.17	D6 1 018/D.6.1.18	D6 1 019/D.6.1.19
Aerial picture lowland area,	Aerial picture lowland area,	Aerial picture lowland area,	Aerial picture lowland area,
presumably Mekong Delta	presumably Mekong Delta	presumably Mekong Delta	presumably Mekong Delta
D6 1 020/D.6.1.20	D6 1 022/D.6.1.22	D6 1 023/D.6.1.23	D6 1 024/D.6.1.24
Aerial picture lowland area,	Aerial picture lowland area,	Aerial picture lowland area,	Aerial picture lowland area,
presumably Mekong Delta	presumably Mekong Delta	presumably Mekong Delta	presumably Mekong Delta

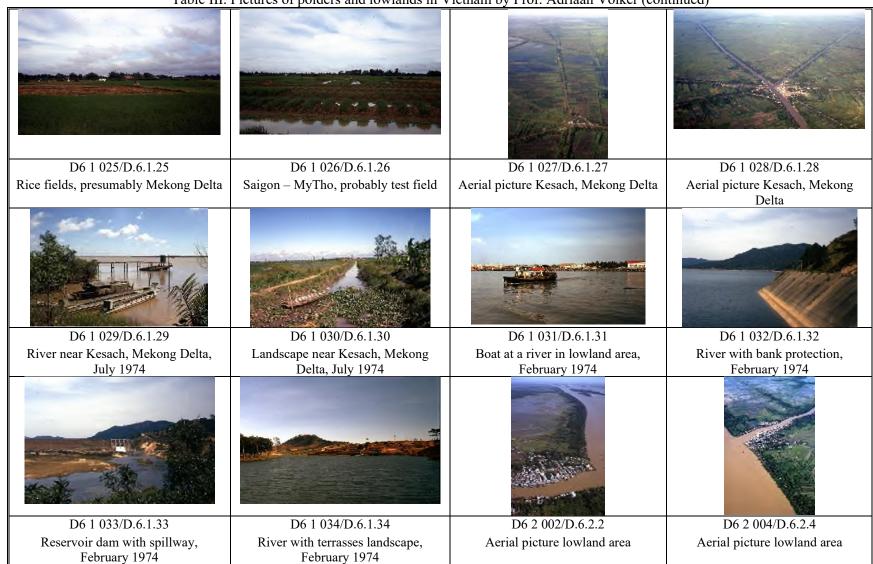


Table III. Pictures of polders and lowlands in Vietnam by Prof. Adriaan Volker (continued)

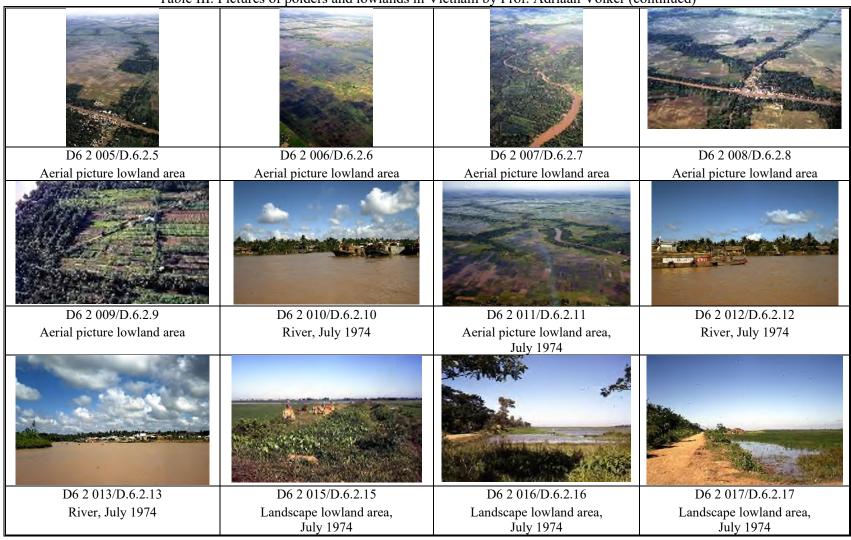
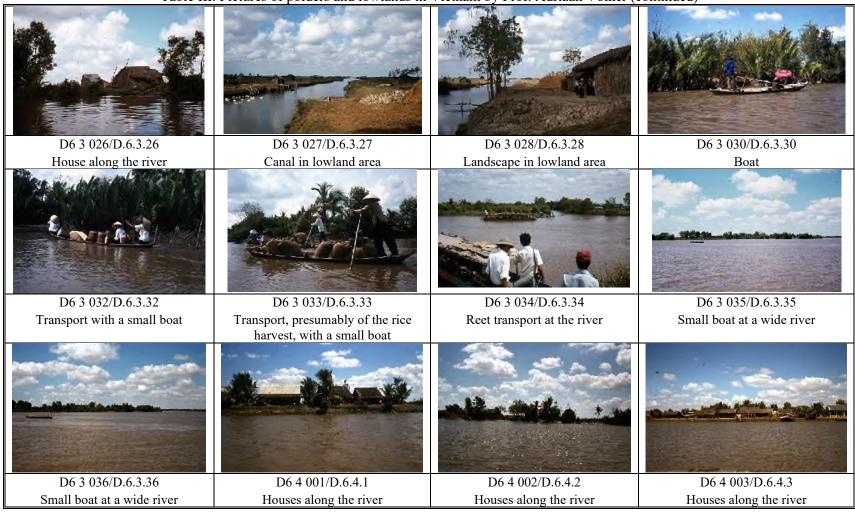




Table III. Pictures of polders and lowlands in Vietnam by Prof. Adriaan Volker (continued)						
D6 3 001/D.6.3.1	D6 3 002/D.6.3.2	D6 3 003/D.6.3.3	D6 3 004/D.6.3.4			
Activities at the river, 1970	River, 1970	Boat with reet, 1970	River, 1970			
D6 3 005/D.6.3.5	D6 3 006/D.6.3.6	D6 3 007/D.6.3.7	D6 3 008/D.6.3.8			
River, 1970	Bank protection, 1970	Boats at the river, 1970	Rice fields, 1970			
D6 3 009/D.6.3.9	D6 3 010/D.6.3.10	D6 3 011/D.6.3.11	D6 3 012/D.6.3.12			
Landscape lowland area, 1970	Houses along the river, 1970	Delivery presumably of the harvest	Traditional boat at the river			





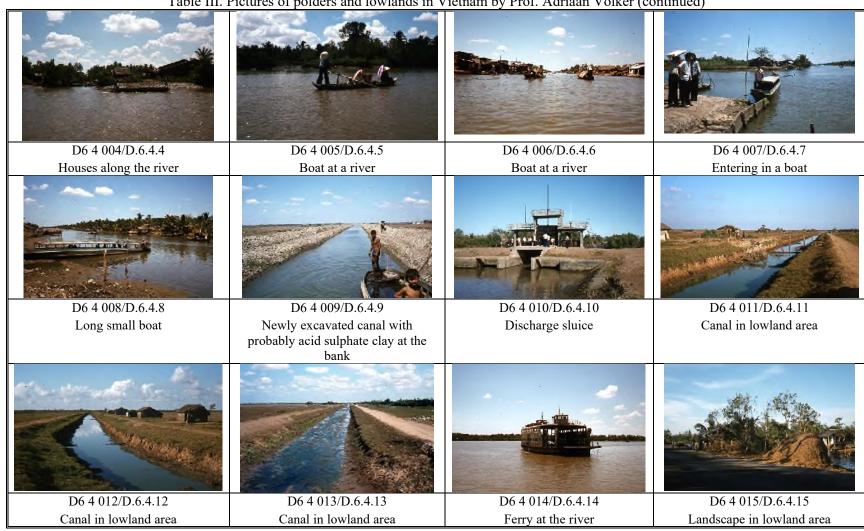
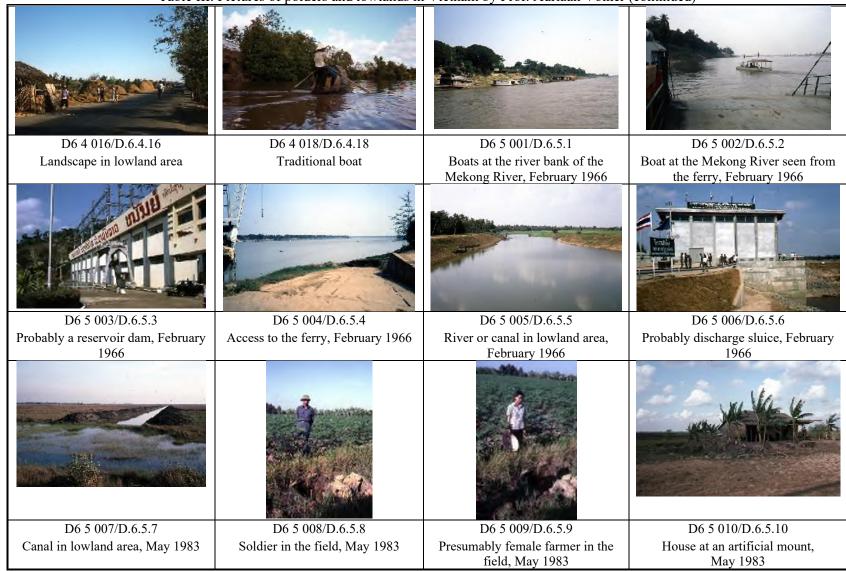
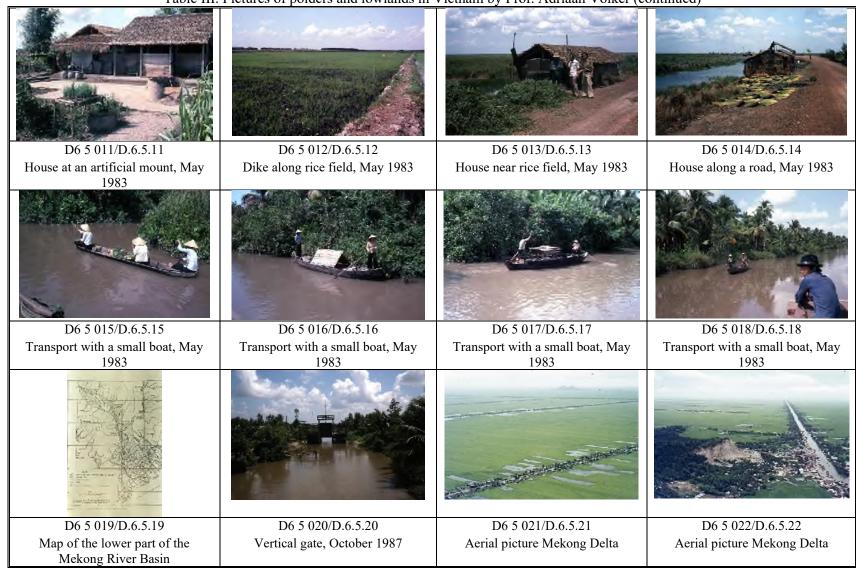
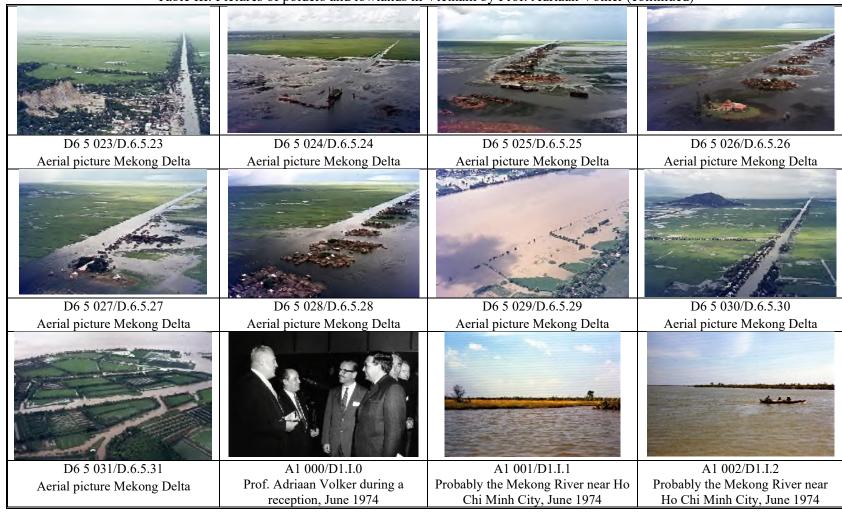
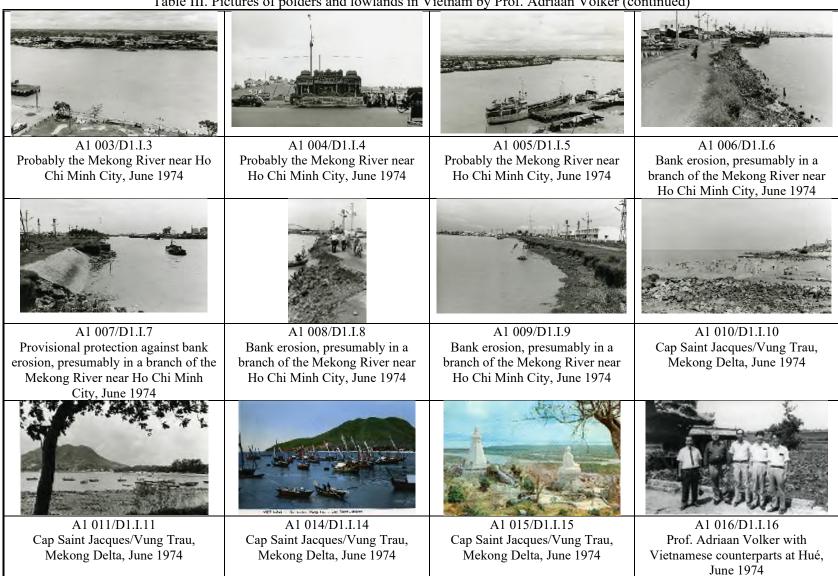


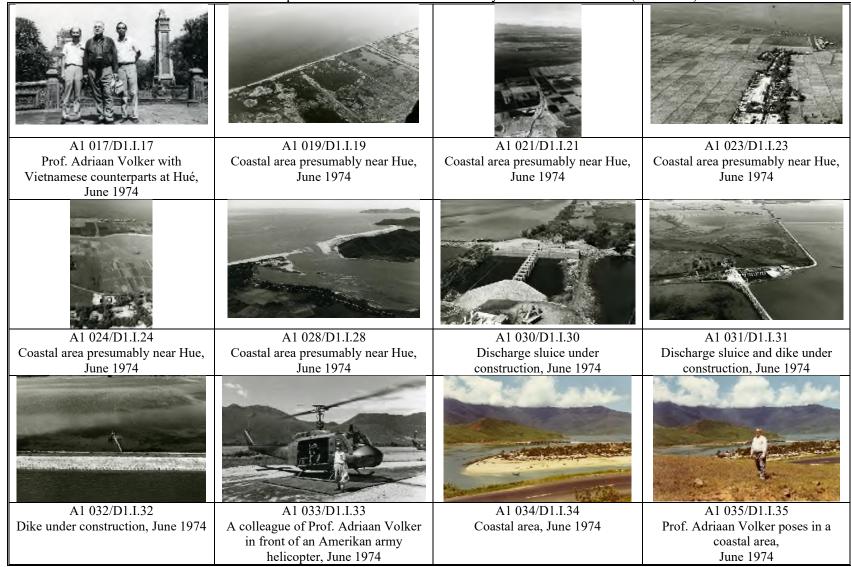
Table III. Pictures of polders and lowlands in Vietnam by Prof. Adriaan Volker (continued)

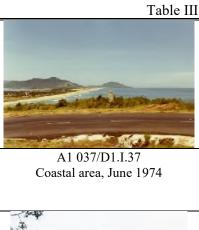


















A1 038/D1.I.38 Coastal area, June 1974

A1 039/ D1.I.39 Prof. Adriaan Volker poses in front of Dalat-Palace, June 1974

A4 001/D1.IV.1 Canal in the Red River Delta that is possibly suitable for irrigation, as well as for drainage, 1981







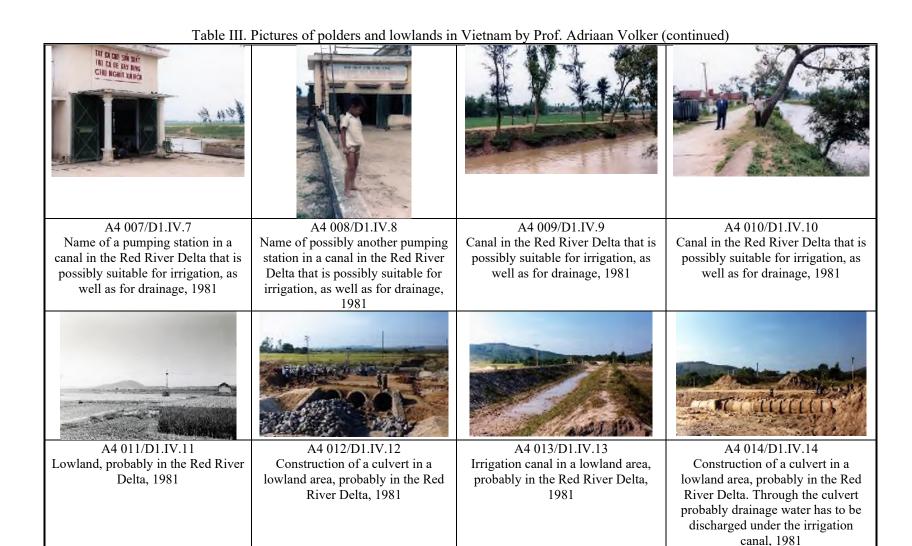


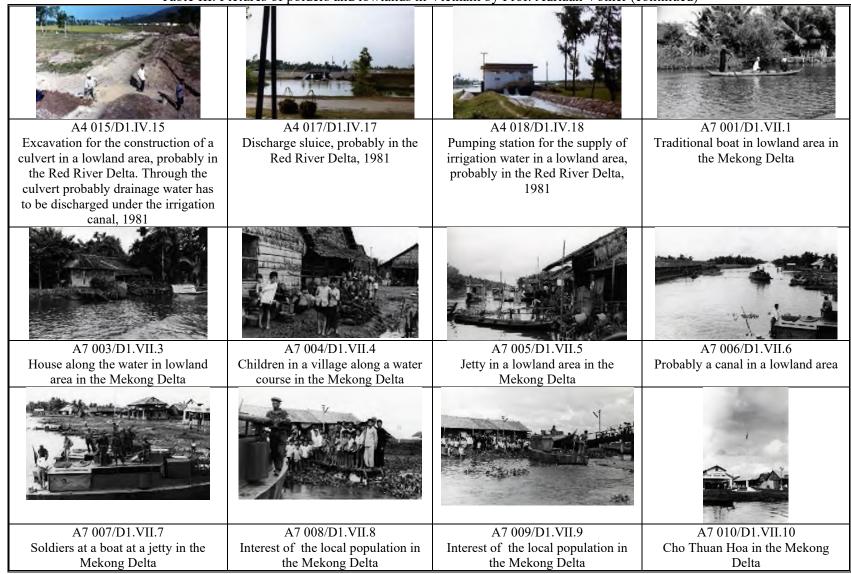
A4 003/D1.IV.3 Sluice with vertical gates in a canal in the Red River Delta that is possibly suitable for irrigation, as well as for drainage, 1981

A4 004/D1.IV.4
Pumping station in a canal in the
Red River Delta that is possibly
suitable for irrigation, as well as for
drainage, 1981

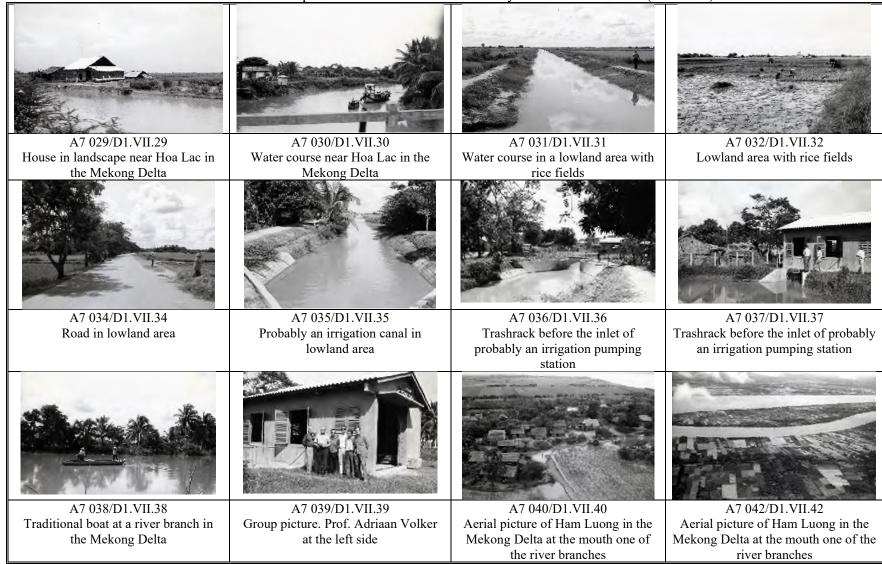
A4 005/D1.IV.5 Sluice with vertical gates in a canal in the Red River Delta that is possibly suitable for irrigation, as well as for drainage, 1981

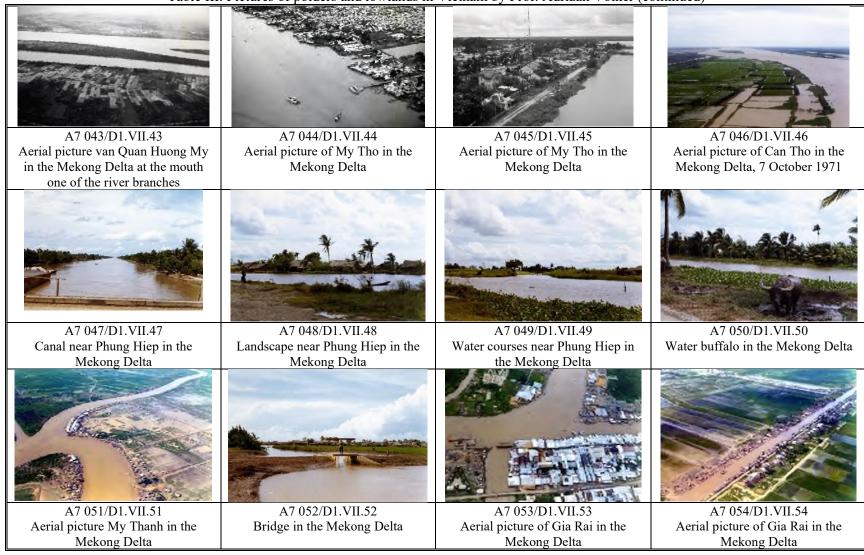
A4 006/D1.IV.6
Sluice with vertical gates in a canal in the Red River Delta that is possibly suitable for irrigation, as well as for drainage, 1981

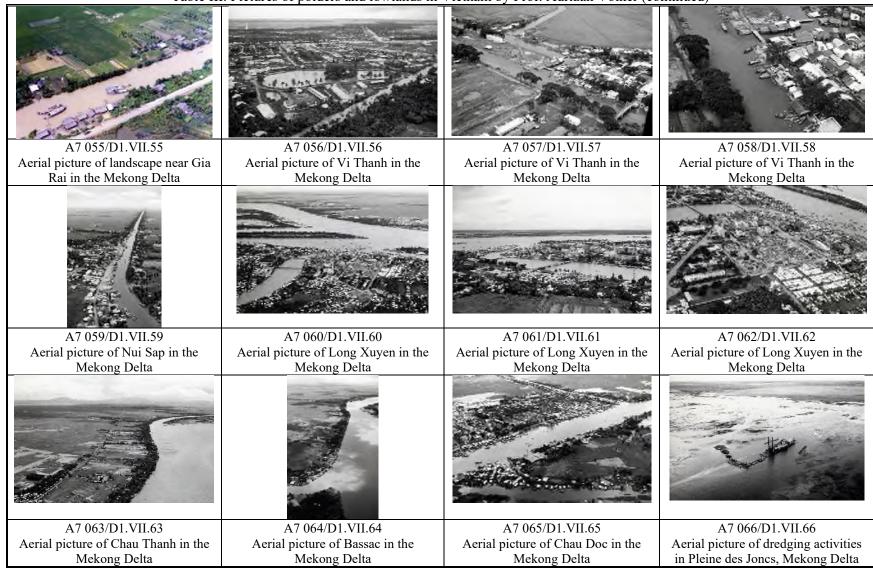












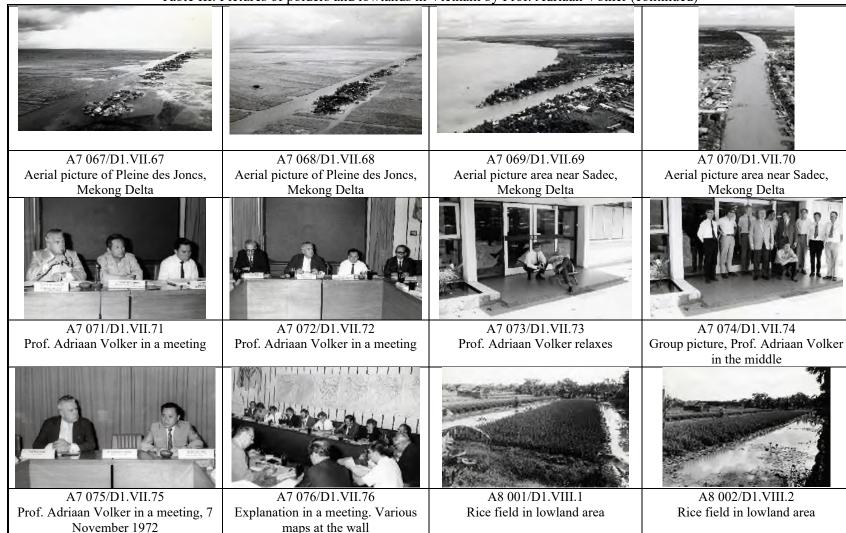
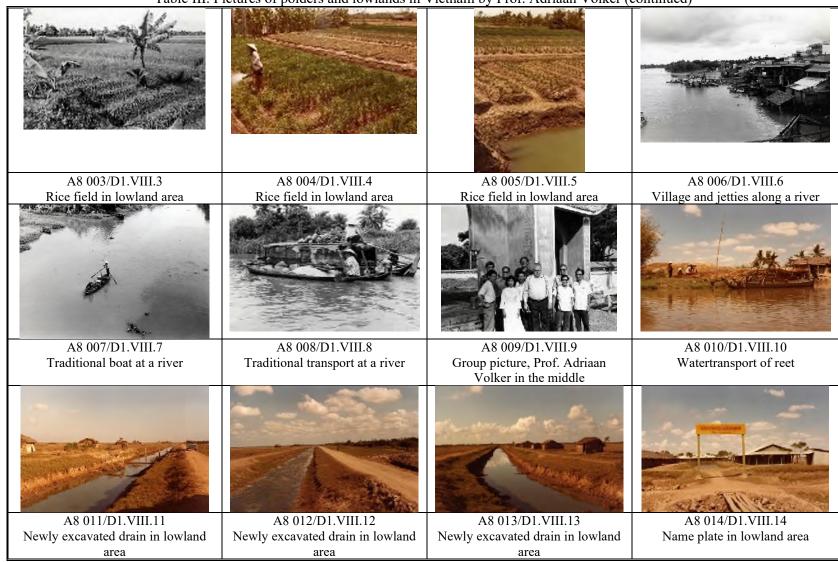
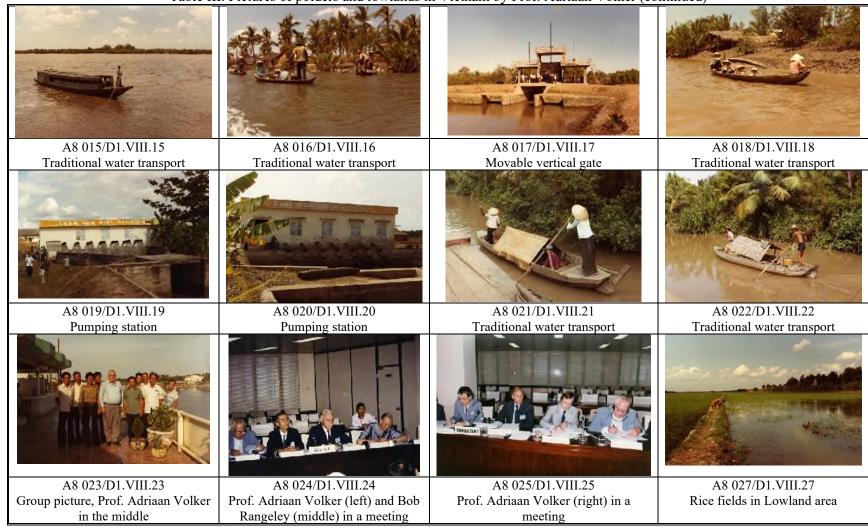
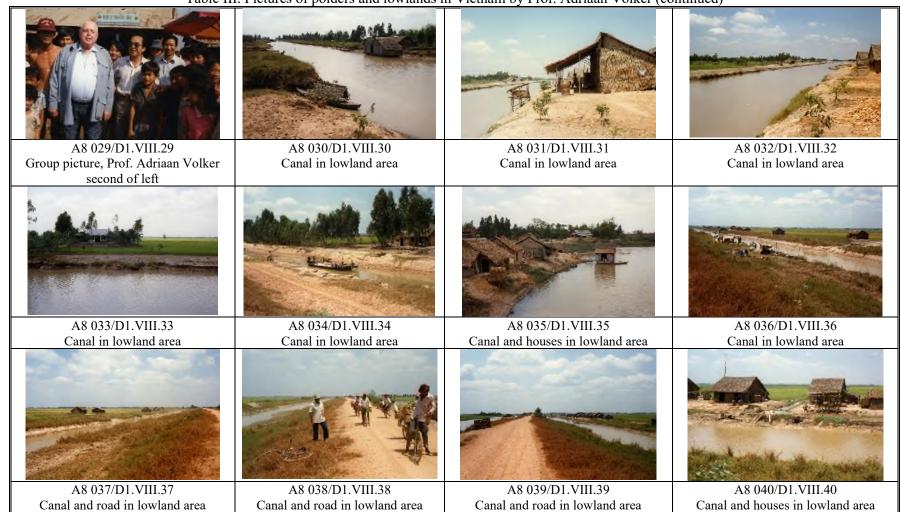


Table III. Pictures of polders and lowlands in Vietnam by Prof. Adriaan Volker (continued)









A8 041/D1.VIII.41
Road with trees in lowland area



A8 042/D1.VIII.42 Group picture, Prof. Adriaan Volker left



A8 043/D1.VIII.43 Canal and houses in lowland area



A8 044/D1.VIII.44 Canal and houses in lowland area

Table IV. Pictures of polders and lowlands in Vietnam by Prof. Bart Schultz

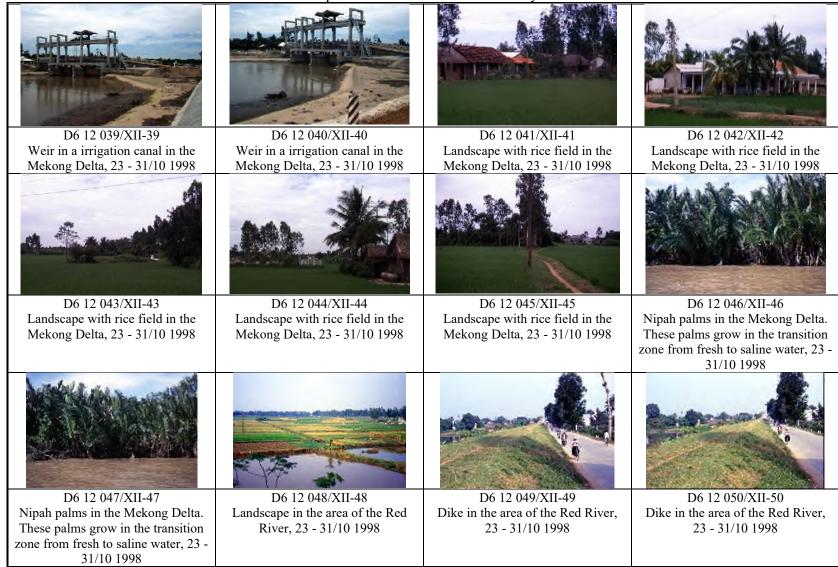
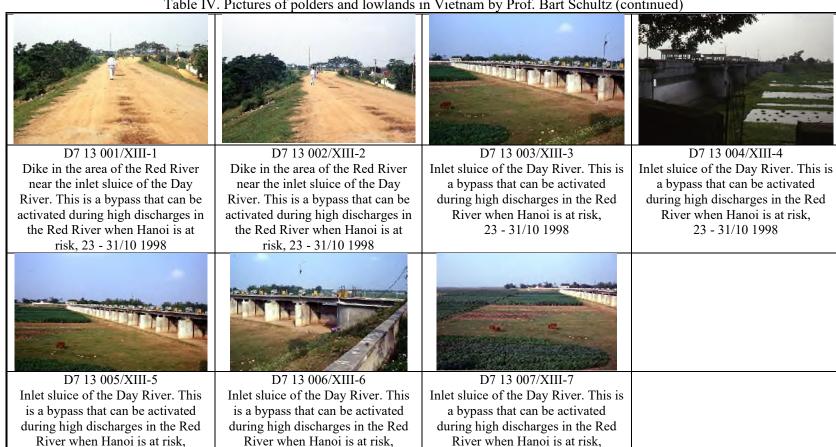


Table IV. Pictures of polders and lowlands in Vietnam by Prof. Bart Schultz (continued)



23 - 31/10 1998

23 - 31/10 1998

23 - 31/10 1998