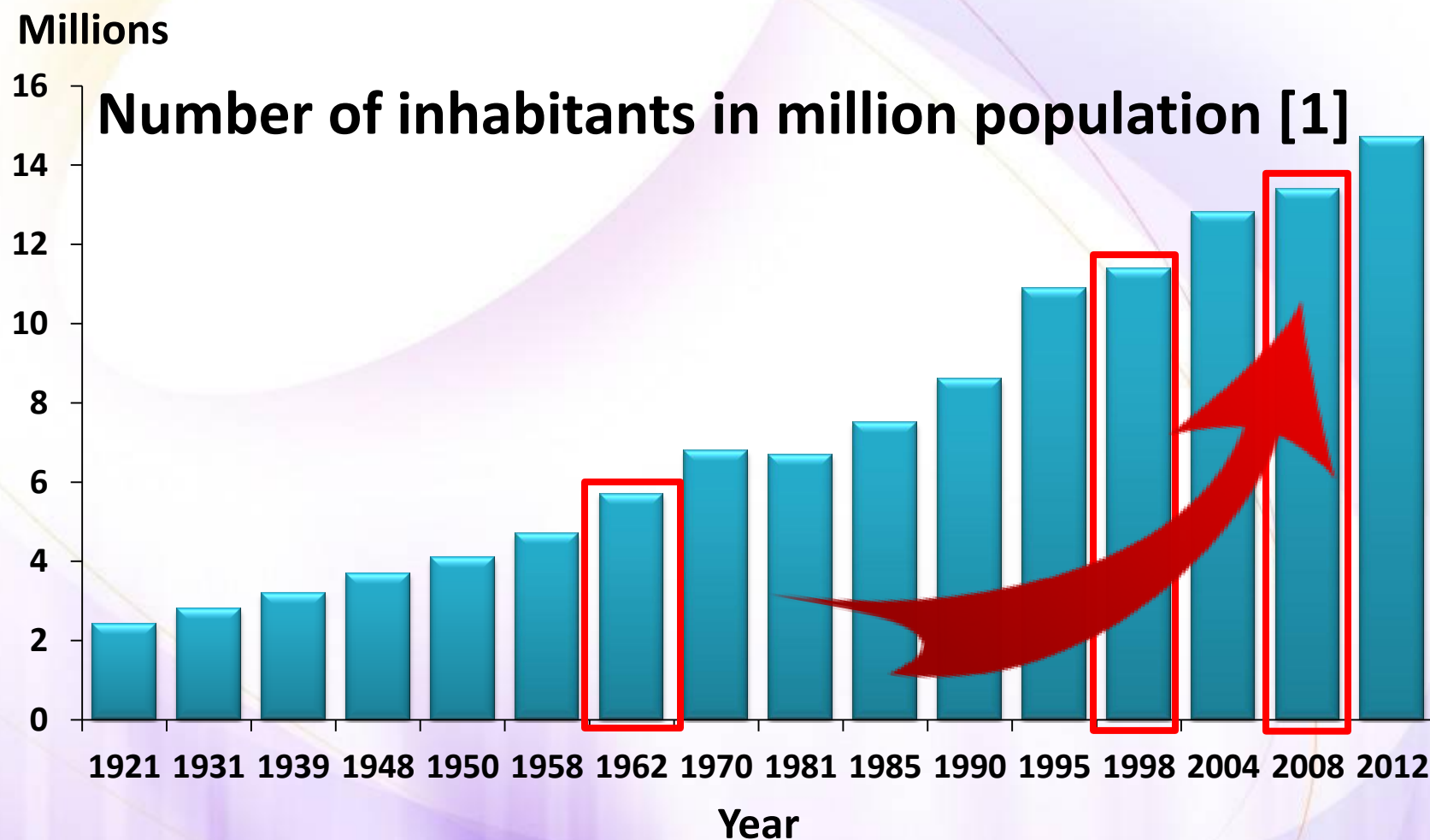


Good Practice *Biogas* (NBP)

Dr. Kuok Fidero



Overview of Cambodian population

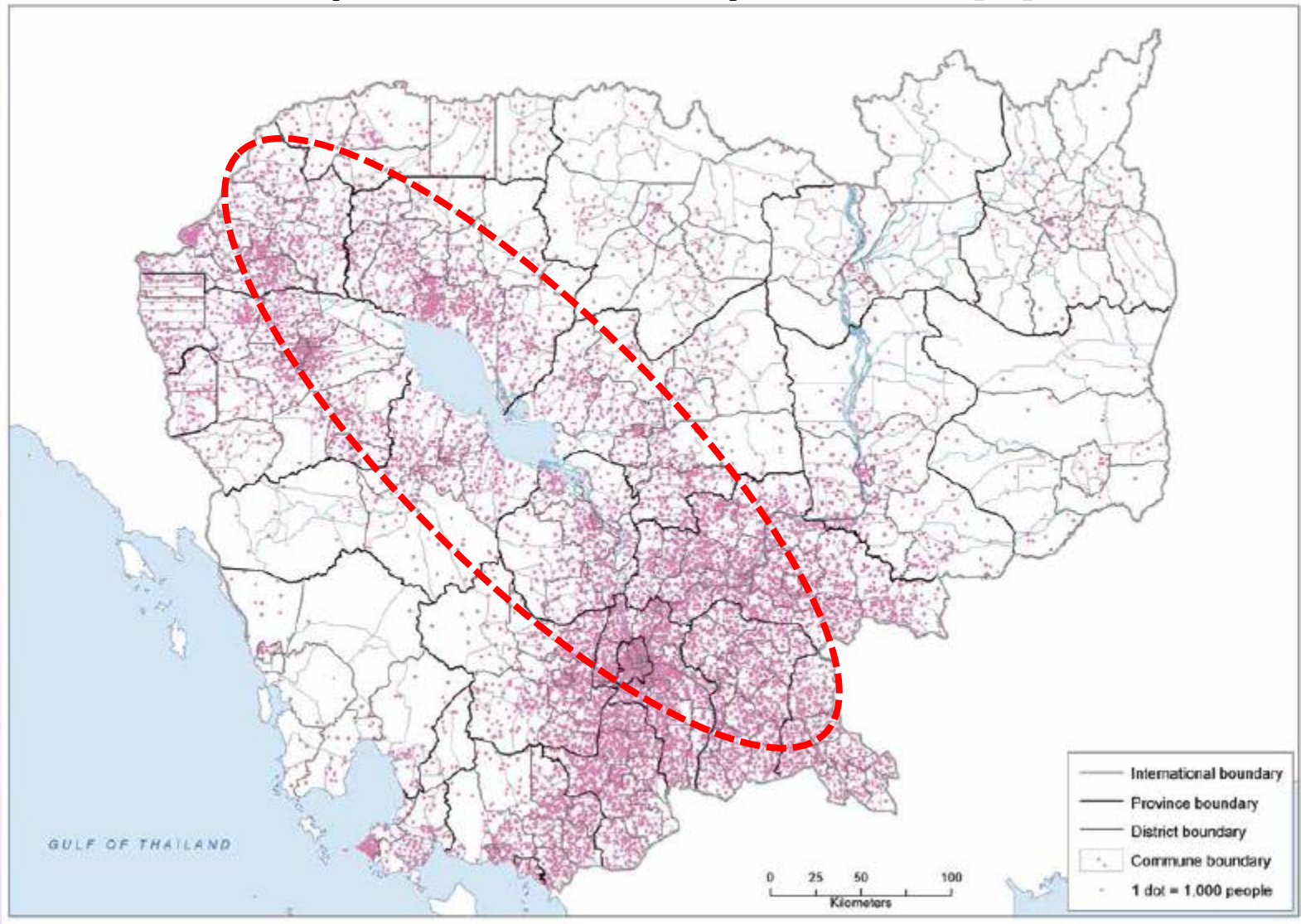


Note: 1-There were three censuses since 60s, population census in 1962, 1998, and the last census in 2008.

2-CIPS: Cambodia Inter-censal Survey in 2004

Overview of Cambodian population

Population Density in 2008 [2]

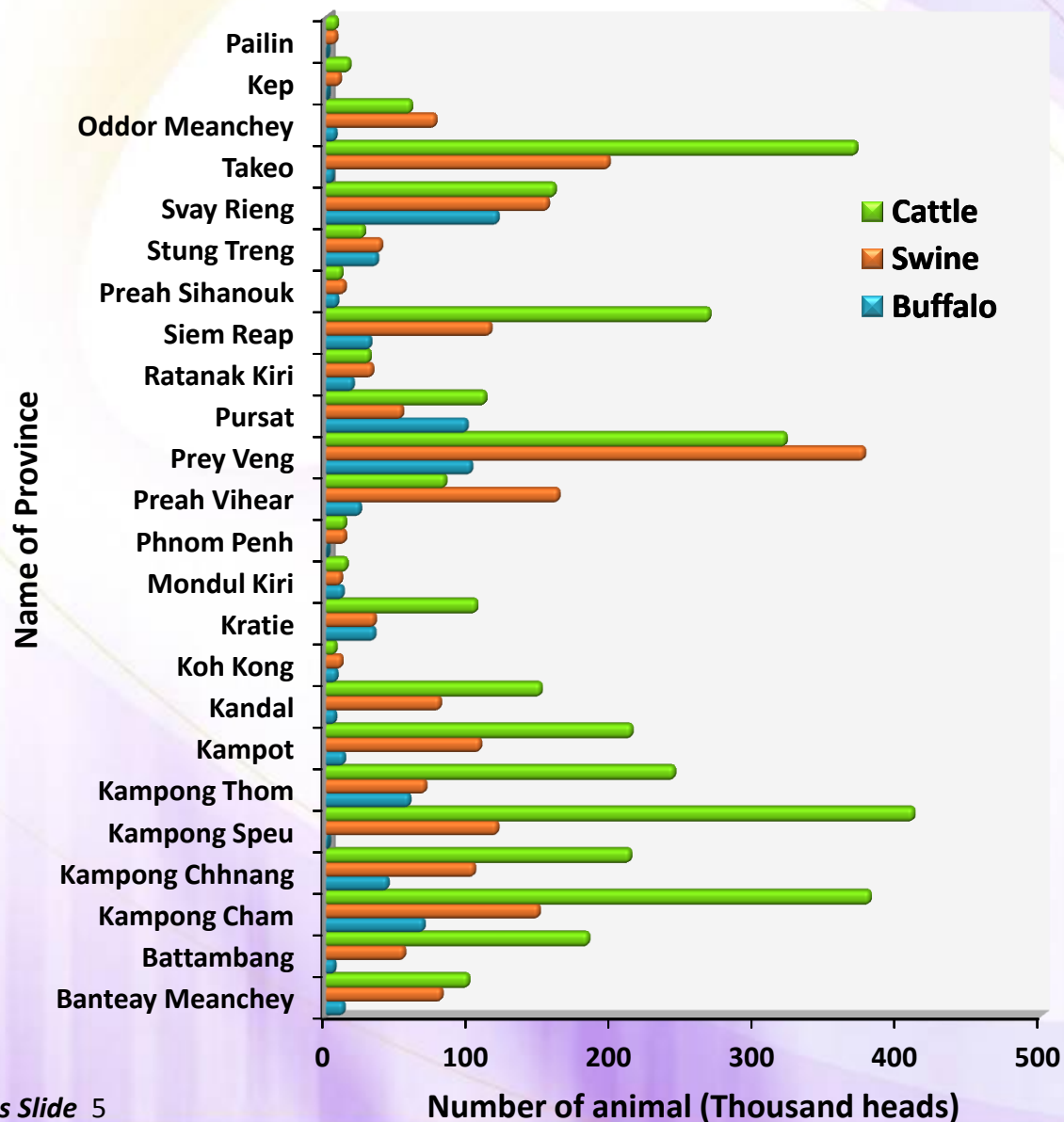


Overview of Cambodian population

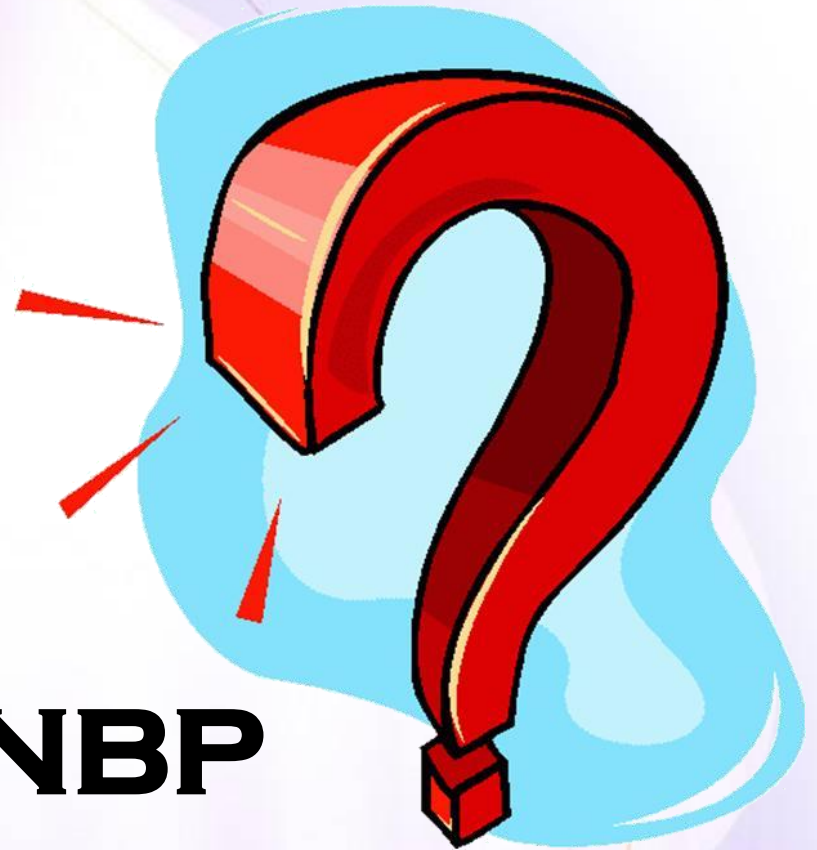
Average Household Size by Province in 2008 [1]



Livestock inventory by province 2010 in Cambodia [1]

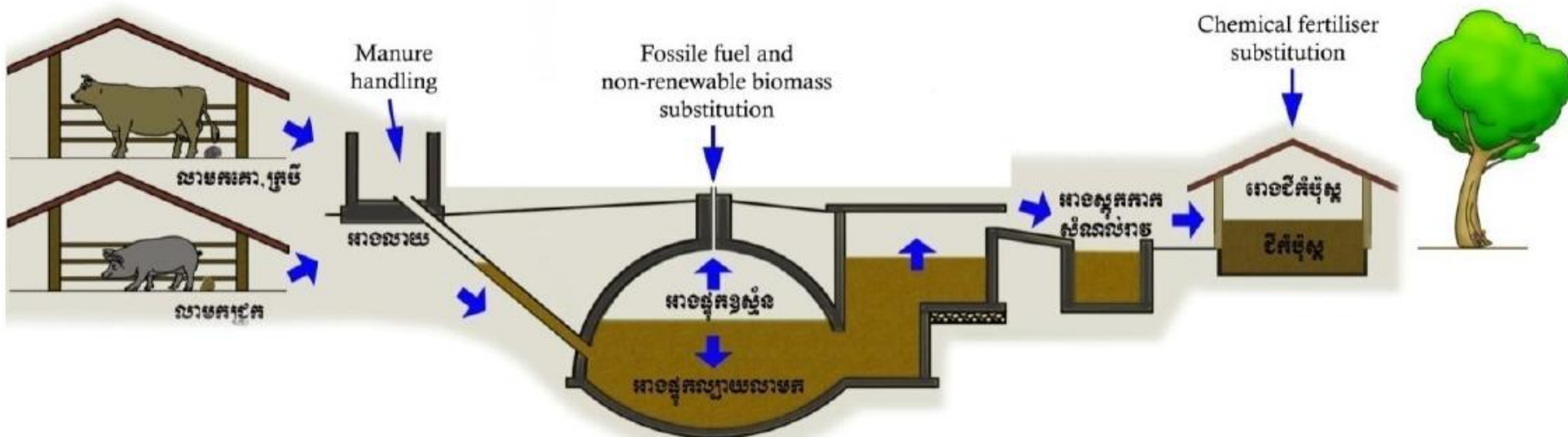


WHAT IS NBP

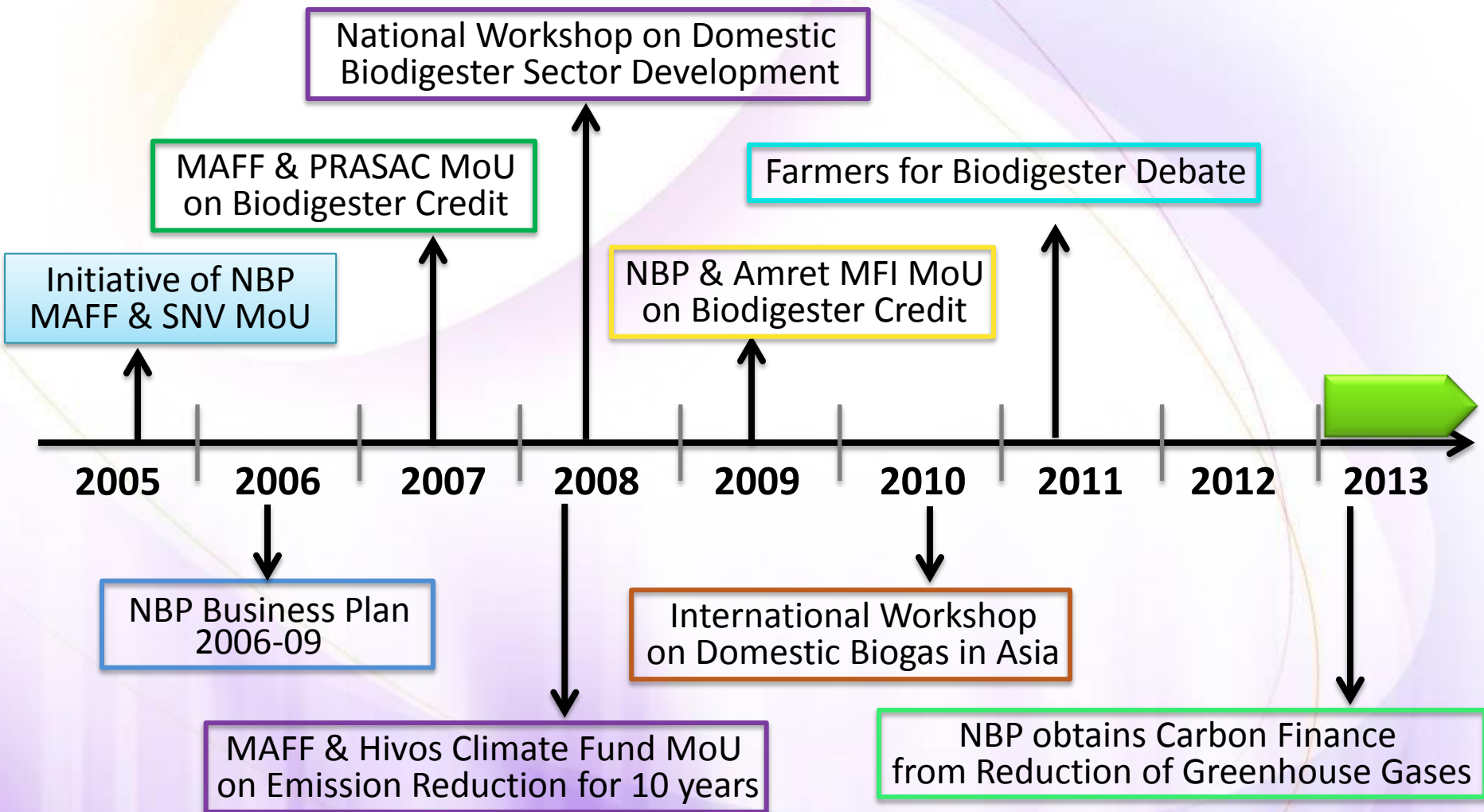




National Biodigester Programme (NBP) in Cambodia

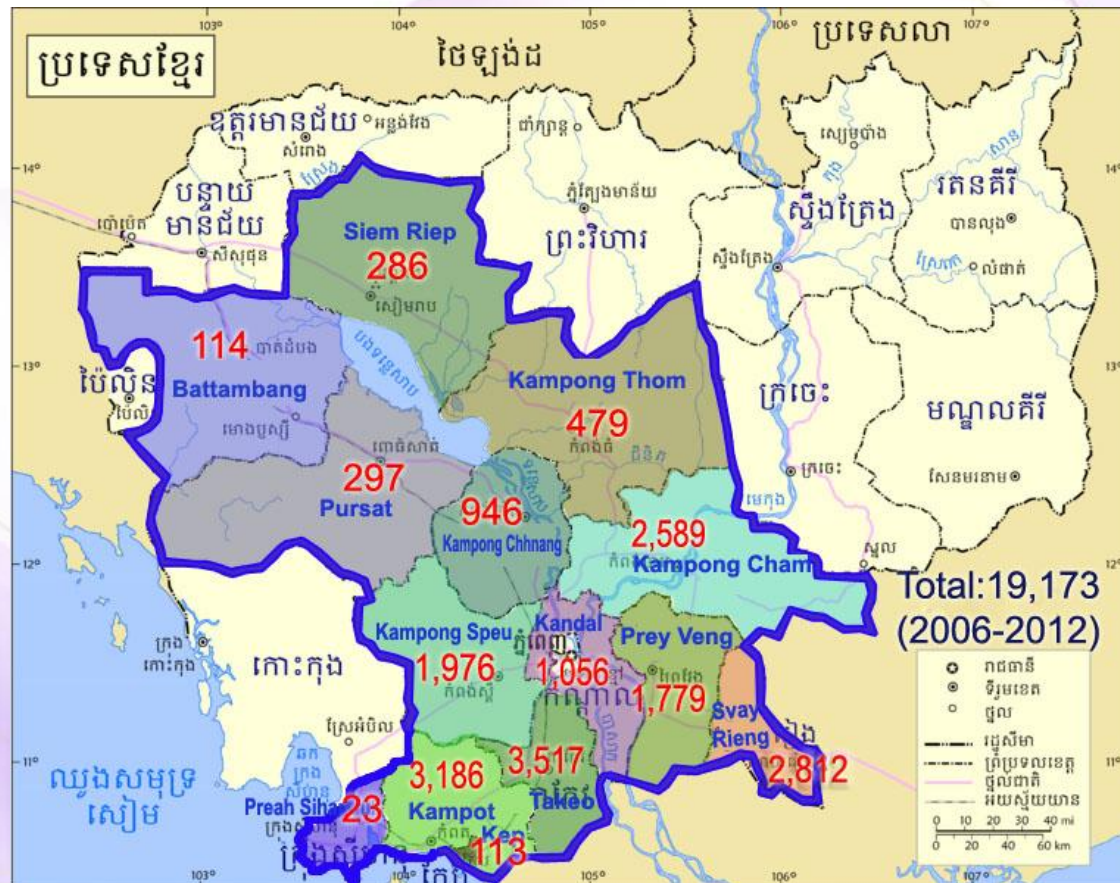


History of NBP in Cambodia



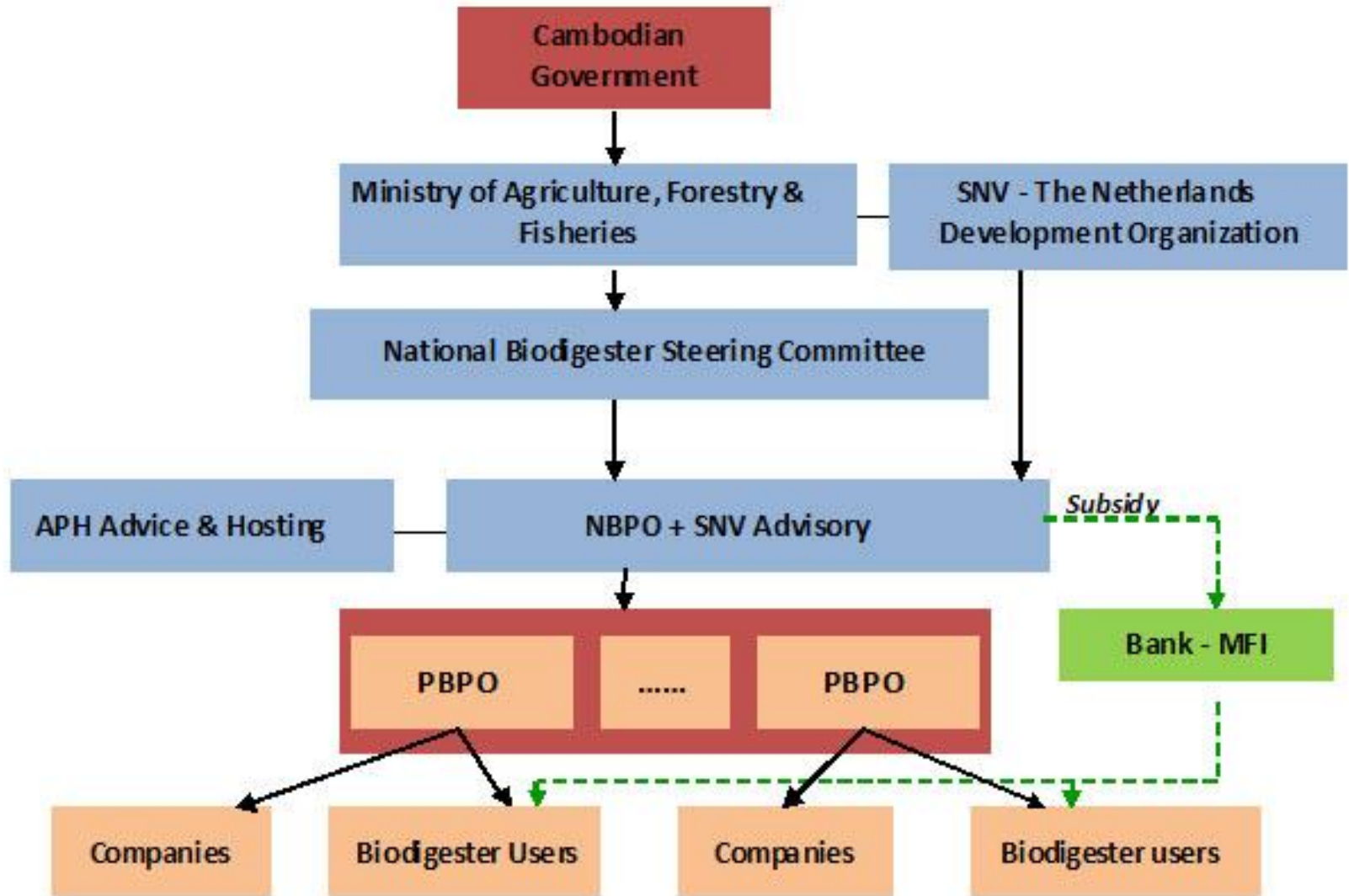
Objective & Program Area of NBP in Cambodia

- **Objective:** *The overall objective of the first phase of the National Biodigester Programme is the dissemination of domestic biodigesters as an indigenous, sustainable energy source through the development of a commercial, market oriented, biodigester sector in selected provinces of Cambodia.*
- **Program Area:**



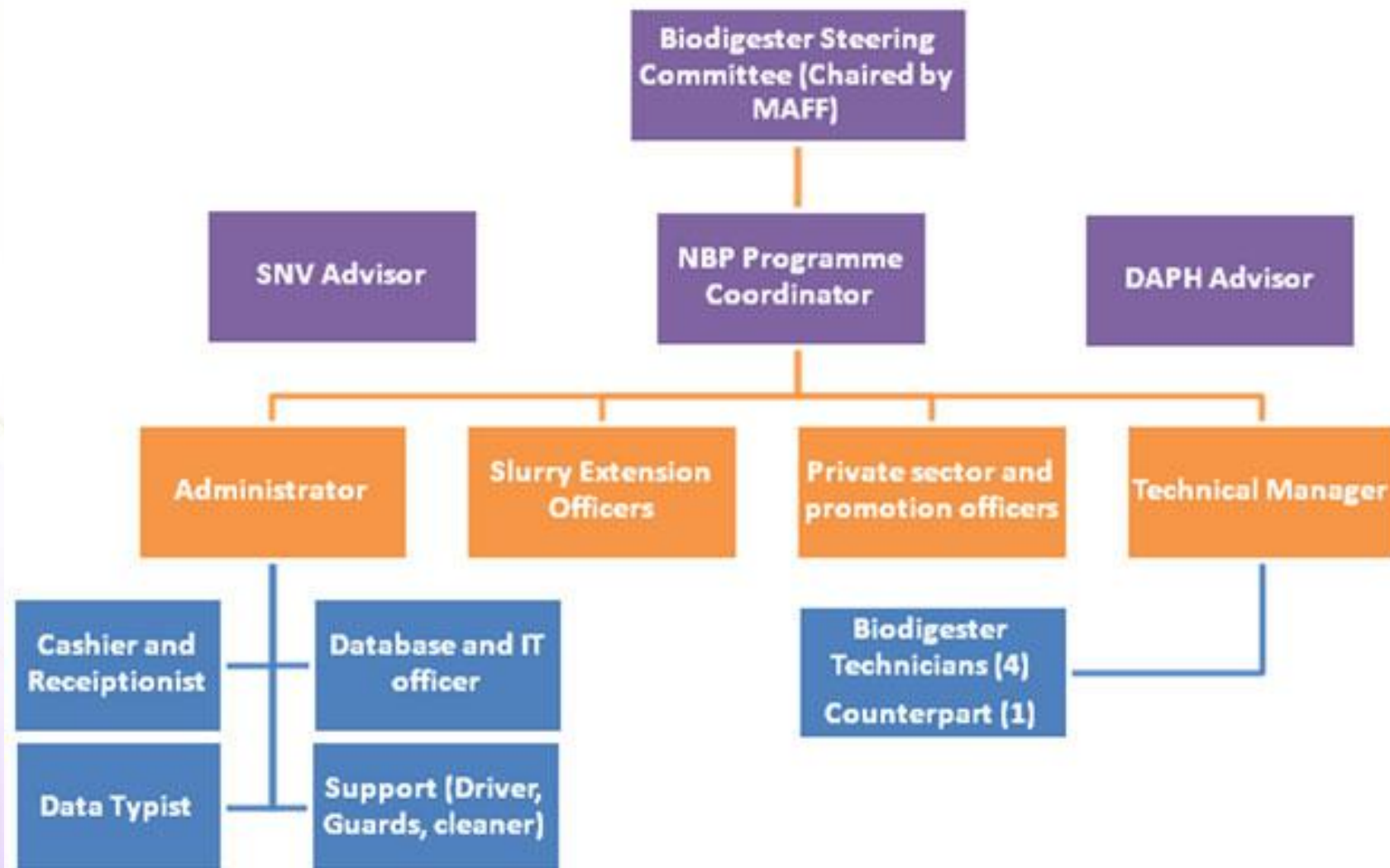
Structure of NBP in Cambodia

NATIONAL BIODIGESTER PROGRAM



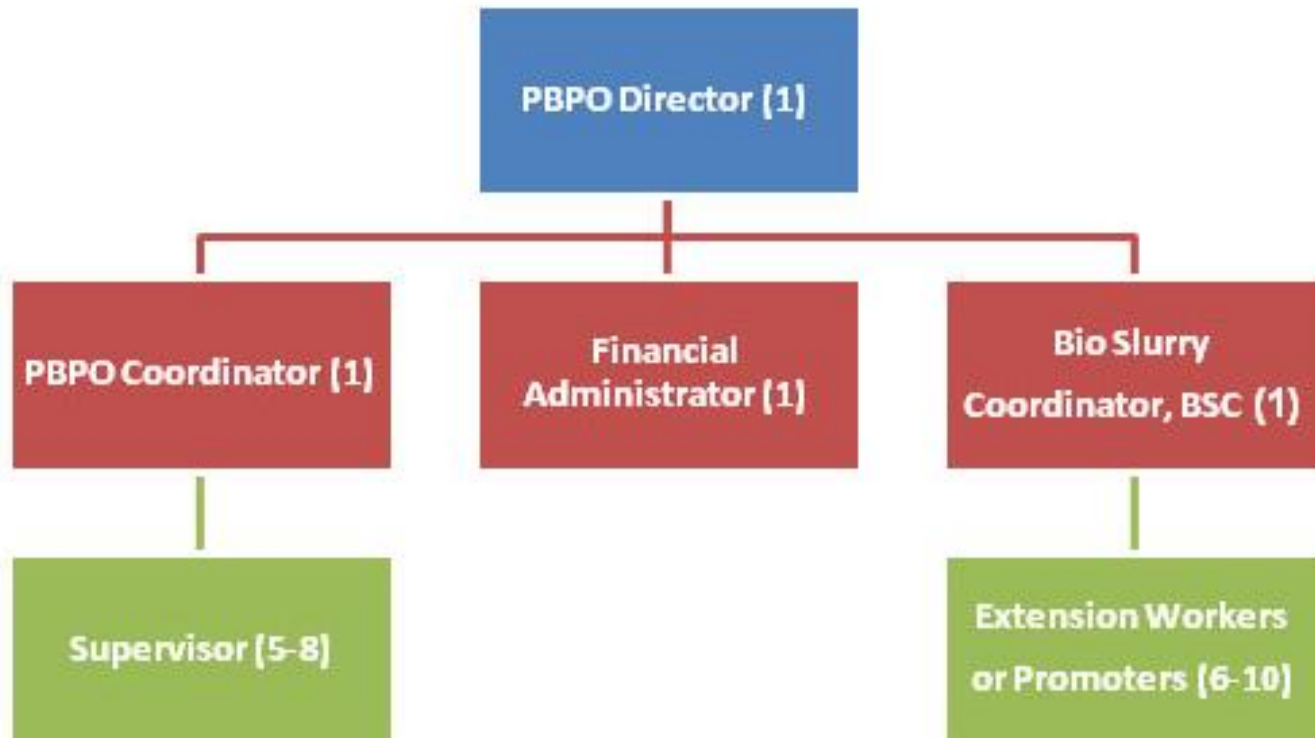
Structure of NBP in Cambodia

NBP ORGANIZATION CHART



Structure of NBP in Cambodia

PROVINCIAL BIODIGESTER PROGRAM OFFICE (PBPO)



Biodigester Technology

- **Biogas** originates from bacteria in a process of bio-degradation of organic materials under anaerobic (without air) conditions.

Table 1. Characteristics of biogas [3]

Description	Volume (%)
Methane (CH_4)	50 – 70
Carbon dioxide (CO_2)	30 – 40
Hydrogen (H_2)	5 – 10
Nitrogen (N_2)	1 – 2
Water vapour (H_2O)	0.3
Hydrogen sulfide (H_2S)	Traces

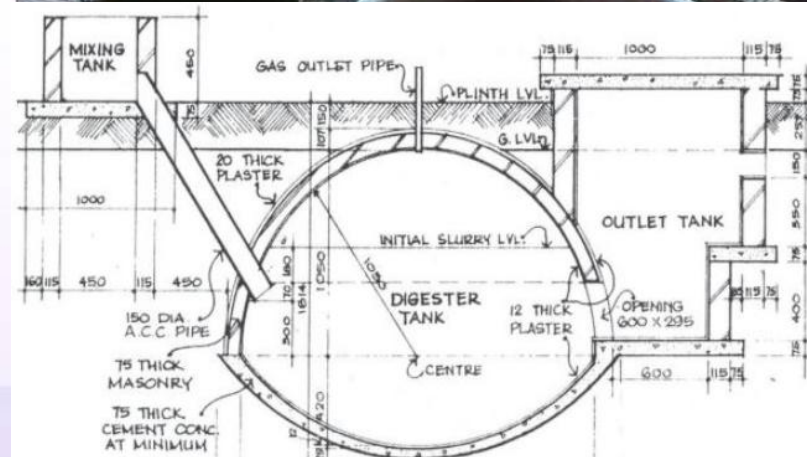


Figure 1. Deen-bandhu biodigester model-India [3]

Biodigester Construction Steps

Choosing biodigester site

Constructing biodigester

Soil backfilling biodigester

Filling animal manure

Connecting light & gas-stove



Feeding and Biodigester Size

Table 2. Feeding quantity and plant volume [3]

Biodigester size	Initial feeding (Cattle or swine manure, kg)	Daily manure feeding (kg)	Water addition (L)	Use of biogas stove (h)	Use of biogas lamp (h)
4	1500	20-40	20-40	2-4	8-16
6	2300	40-60	40-60	4-6	16-24
8	3000	60-80	60-80	6-8	24-32
10	3800	80-100	80-100	8-10	32-40
15	6000	100-150	100-150	10-15	40-60

Note: A biogas stove consume 400 liters of biogas per hour, a biogas lamp consume 100 liters of biogas per hour, 1 kg of animal manure produces approximately 40 liters of biogas.

Biogas Production

Table 3. Manure and biogas production per day in warm climate [3]

	Daily manure production (kg)	Biogas production in 1 kg of manure/faeces (L)
Cattle manure	10 – 15	40
Buffalo manure	15 – 20	35
Swine manure	2 – 4	50
Chicken manure	0.02 – 0.03	60
Human faeces	0.18 – 0.34	50

Note: The daily manure production is estimated based on the normal seized adult animal.

Programme Benefit and relation to MDG

- **Gender:** *Improving and saving time for women in preparation of foods.*
- **Environmental aspects:** *Maintaining the ecological cycle, promoting sustainable and renewable energy, improving soil fertility.*
- **Poverty, employment and health:** *Cutting the energy costs, creating biodigester construction job, better hygienic condition and health.*
- **National strategy (MDGs/PRSP) and NBP targets**

MDG	National Poverty Reduction Strategy 2003-2005, December 2002	NBP targets (2005-2010)
1	<ul style="list-style-type: none"> Page 194: Promote an adequate and reliable supply of energy for household uses Page 195: Study and install renewable energy facilities Page 192: Create rural employment Page 194: Improve labour productivity and skills of Cambodians through provision of vocational training 	<ul style="list-style-type: none"> 17,500 plants constructed 105,000 people reached 1,200 man-years employment created 1,750 professionals trained
3	<ul style="list-style-type: none"> Page 229: Ensure equal access of women [...] to economic resources and opportunities and equitable participation. 	<ul style="list-style-type: none"> 9,900 years workload reduced (mainly for women)
6	<ul style="list-style-type: none"> Page 204: Promote household hygienic latrine construction Page 203: Promote healthy lifestyle and disease prevention 	<ul style="list-style-type: none"> 1,750 toilets attached 52,500 women & children less exposed to indoor air pollution
7	<ul style="list-style-type: none"> Page 179: Promote sustainable natural resources management and conservation 	<ul style="list-style-type: none"> 99,000 ton biomass saved 123,000 ton CO₂-eq reduced

Programme Benefit and Relation to MDG

- **MDG 1: Eradicate extreme poverty and hunger**
-Target is to halve extreme poverty.
- **MDG 3 Promote gender equality and empower women**
-Target is to eliminate gender disparity in education.
- **MDG 6 Combat HIV/AIDS, malaria and other diseases**
-Target is to halt / reverse the incidence of malaria and other major diseases.
- **MDG 7 Ensure environmental sustainability**
-Target is to integrate the principles of sustainable development into country policies and program and reverse the loss of environmental resources.
- Target is to halve the proportion of people without sustainable access to safe drinking water and basic sanitation.

Benefits of Biodigester Technology

Economic Benefits

- Save expenditures on fuel sources such as fuel-wood, charging battery, kerosene
- Save time to utilize in other income generation activities
- Save health care expenditures due to decrease in smoke-borne diseases
- Provide employment to local people
- Develop private sector to produce economic goods
- Promote livestock health development



Figure 2. Economic benefits of biodigester [3, 4, 5]

Benefits of Biodigester Technology

Economic Benefits

- Enhance soil productivity because of the use of bio-slurry
- Reduce the quantity of chemical fertilizers due to the use of biodigester effluent



Figure 3. Bio-slurry in forms of liquid, semi-solid, and solid [6]

Benefits of Biodigester Technology

Economic Benefits

- Enhance soil productivity because of the use of bio-slurry
- Reduce the quantity of chemical fertilizers due to the use of biodigester effluent



Figure 4. Bio-slurry used during vegetables and rice production [6]

Benefits of Biodigester Technology

Economic Benefits

- Reduce the feeding cost for the fish raising resulted from the use of bio-slurry to directly/indirectly increase fish food



Figure 5. Bio-slurry used for fish raising [6]

Benefits of Biodigester Technology

Economic Benefits

- Reduce the expenditure on the chemical insecticide used during the vegetable/rice production by using natural insecticide made from bio-slurry together with locally available poisonous plants



Figure 6. Bio-slurry used for the production of natural insecticide [6]

Benefits of Biodigester Technology

Health Benefits

- Reduce smoke borne diseases and air pollution
- Improve household sanitation and kitchen
- Decrease burning/fire accidents



Benefits of Biodigester Technology

Environmental Benefits

- Preserve/conserve forest, fossil- and non renewable biomass fuel
- Reduce green-house gases especially the methane
- Prevent land-fertility degradation due to excessive use of chemical fertilizers

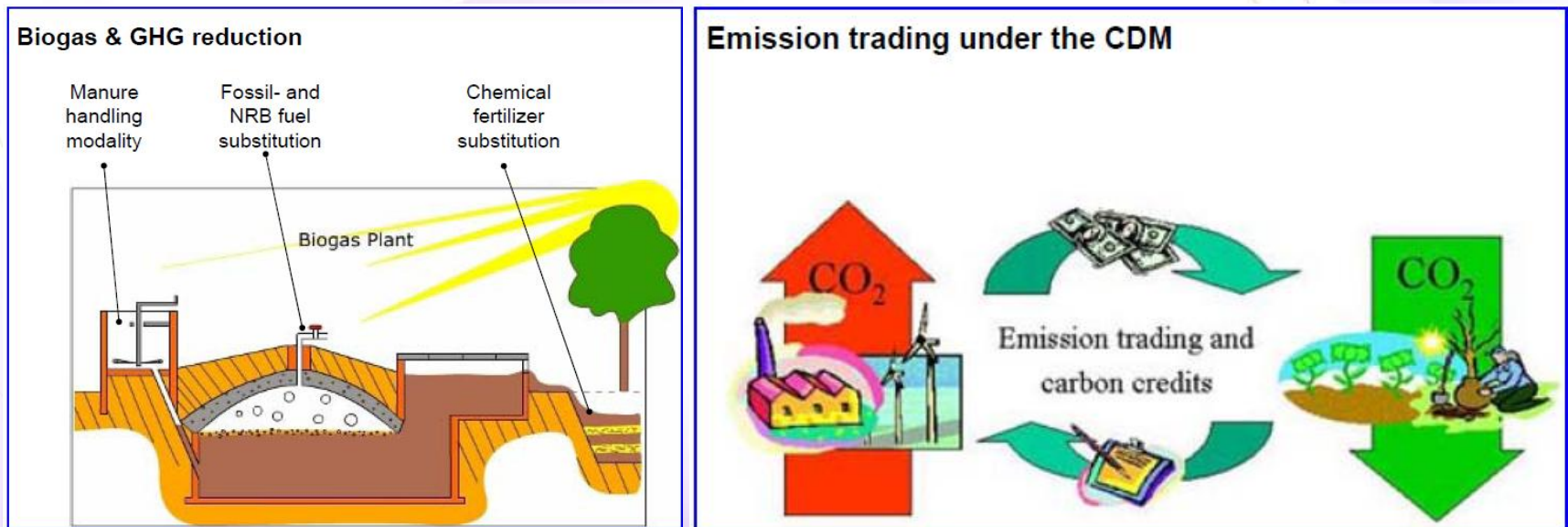


Figure 7. Green house gas (GHG) reduction and emission trading with the use of biodigester [7]

Benefits of Biodigester Technology

Environmental Benefits

- Eliminate smell from manure storage ponds at swine/cattle farms
- Reduce water pollution from animal manure being dumped into surface water

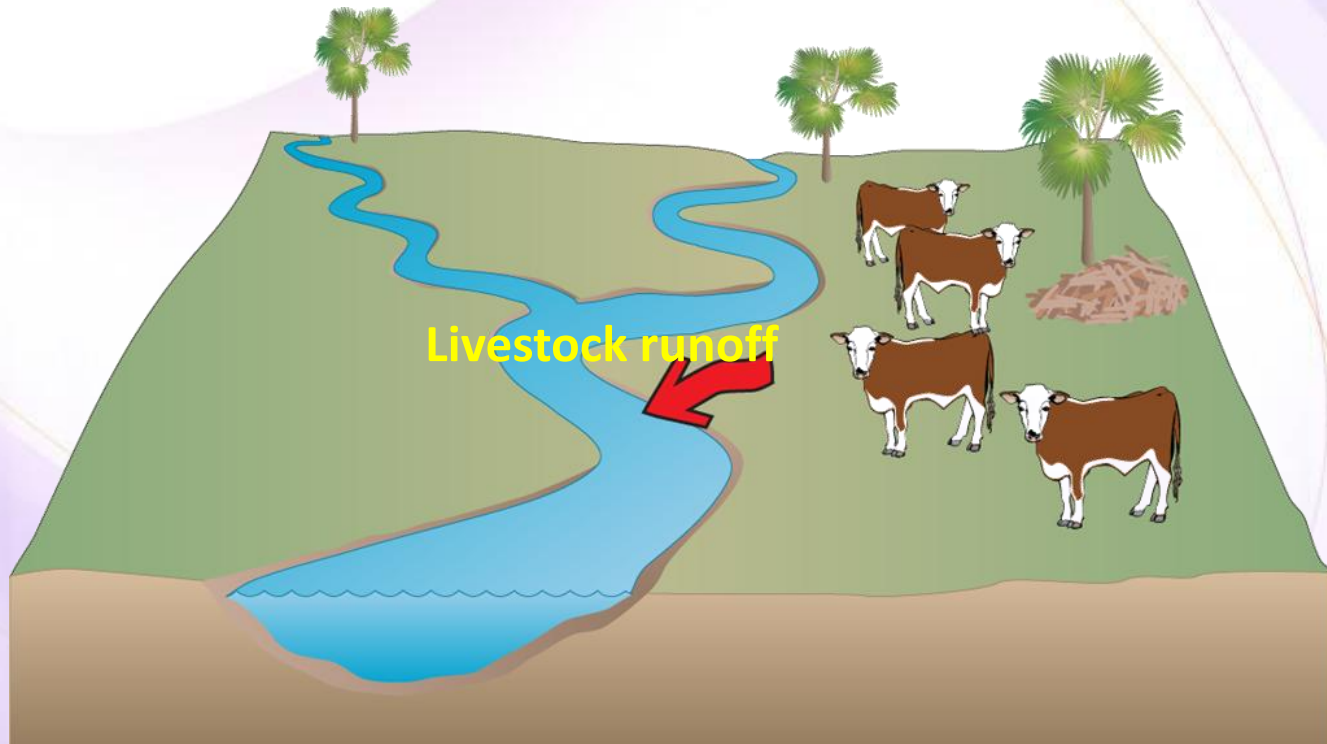


Figure 8. Water pollution from livestock runoff

Benefits of Biodigester Technology

Social Benefits

- Extra time for social activities.
- Enhance prestige in the community.
- Reduce workload especially for women.
- Bright light to help in quality of education and household works.
- Increase in rate of enrollment of girls in school



Biodigester Costs

Table 4. Biodigester construction cost [3]

Item	Total cost of biodigester (USD)				
	4 m ³	6 m ³	8 m ³	10 m ³	15 m ³
Construction materials (Purchasing from market)	258.95	315.75	380.05	436.65	669.35
Appliances/ accessories (Purchasing from market)	20.48	20.48	20.48	20.48	20.48
Appliances/ accessories (Purchasing from NBP)	34.50	34.50	34.50	34.50	34.50
Labours	80.00	89.50	107.00	126.00	167.50
Training participation and guarantee fee	25.00	30.00	35.00	40.00	50.00
Grand total	<u>418.93</u>	<u>490.23</u>	<u>577.03</u>	<u>657.63</u>	<u>941.83</u>

*Note: - After the plant constructed, the plant owner will get US\$ 150 per plant from NBP.
 - The cost can be varied between $\pm 5\%$.
 - The participation fee will be spended by the plant owner on the services and materials received from Provincial Biodigester Programme Offices (PBPOs).
 - The guarantee fees will keep in the PBPO saving account and will transfer to mason when the guarantee period 2 year has expired and subscribed by the PBPO.*

Financial Viability

Table 5. Payback period of 4 m³ capacity biodigester (construction cost 418.93 USD) [3]

Type of fuel sources	Quantity saved	Cost per kg (USD)	Total cost saved per day (USD)	Payback period without subsidy	Payback period with subsidy US\$ 150
Firewood	6.0 kg	0.07	0.42	2.7 years	1.8 years
Charcoal	2.0 kg	0.20	0.40	2.9 years	1.8 years
Kerosene	0.7 liter	0.65	0.46	2.5 years	1.6 years
LPG	0.5 kg	1.00	0.50	2.3 years	1.5 years

Note: - This cost analysis is only the direct and measurable returns cost of a biodigester mainly on the energy part as most households are buying their fuel and firewood from the marketable commodity in the villages.

Achievements

NBP has successfully achieved the following results from 2006 to 2012:

- Installed 19 173 plants and 95% of them are in operation
- More than 19 thousands families directly benefited by biodigester
- 2 large Microfinance Institutions for Biogas Plant Loan: PRASAC and AMRET
- 65 private Biogas Companies established in 12 provinces
- 1 Biogas appliances manufacturing workshops

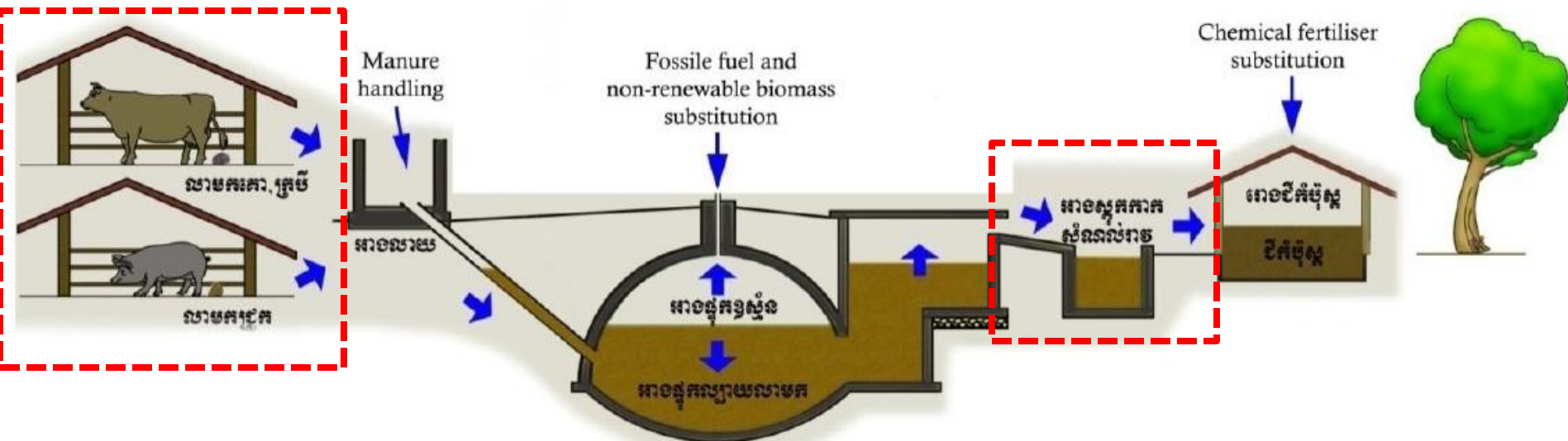
Achievements

NBP has successfully achieved the following results from 2006 to 2012:

- Comprehensive quality standards and quality control system developed
- Numerous of promotional materials and messages publicized
- 12% toilets connected with biodigester plants
- Around 80% of bio-slurry utilized as an organic compost fertilizer
- The program has a warranty of the sale of Verified Emission Reductions (VERs)

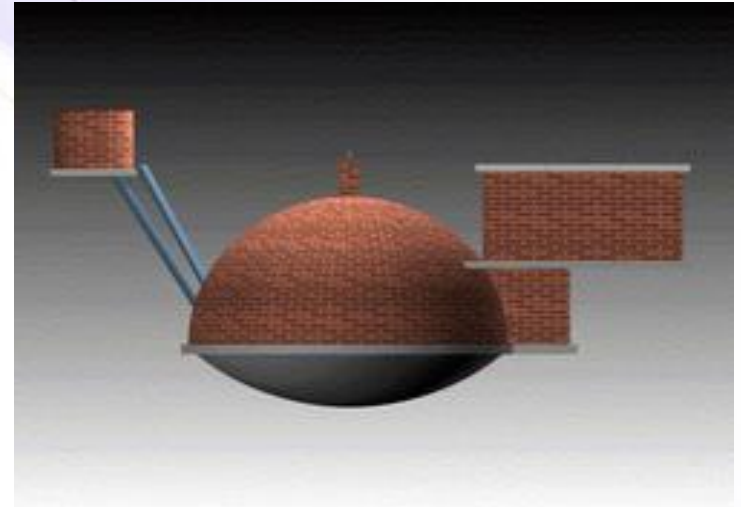
Problems and Challenges

1. Decreasing trend in using cattle/buffalo and in raising livestock
2. Construction of bio-slurry storage without cover
3. Bio-slurry storage is typically far from compost pit
4. Farmer training on the biodigester and bio-slurry management
5. Encourage the use of bio-slurry pellet



Discussing Topics

1. Why Biodigester is important?



2. Why this is a good practice



References

- [1] National Institute of Statistics (NIS). 2012. Statistical yearbook of Cambodia 2011. Ministry of Planning: Phnom Penh.
- [2] National Institute of Statistics (NIS). 2013. Small-area Estimation of Poverty and Malnutrition in Cambodia. Ministry of Planning: Phnom Penh.
- [3] National Biodigester Programme (NBP). 2011. Information folder. Phnom Penh.
- [4] National Biodigester Programme (NBP). 2007. Private sector development study for the national biodigester program Cambodia. Final report. Phnom Penh.
- [5] National Biodigester Programme (NBP). 2011. Biodigester user survey 2009-2010. Phnom Penh.
- [6] National Biodigester Programme (NBP). 2010. Farmer guidebook on the management and utilization of bio-slurry. Phnom Penh. In Khmer.
- [7] SNV Netherlands Development Organization. 2009. Domestic biogas compact course.

A landscape photograph featuring a vibrant green field in the foreground. A single, tall, thin tree with sparse foliage stands on the left side of the field. In the background, a dense line of various green trees stretches across the horizon. The sky is filled with large, white, fluffy clouds against a pale blue background. The text "Thank you" is overlaid in the center of the image in a white, sans-serif font.

Thank you